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Canadian Atlantic Fisheries
Scientific Advisory Committee

CAFSAC Research Document 86/58

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Comité scientifique consultatif des
pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 86/58

East Coast Newfoundland Herring - 1985 Assessment

by

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Abstract

Data analyses for 1985 are presented for the three east coast Newfoundland herring stock complexes: 1) White Bay-Notre Dame Bay, 2) Bonavista Bay-Trinity Bay, and 3) Conception Bay-Southern Shore. Landings from the commercial fishery, which was restricted to gillnets only, were approximately 2500 t. As in 1984, 1979 year-class fish dominated the commercial fishery. Samples from the research gillnet program showed increased catches of the 1982 year-class. Similarly, the acoustic purse seine survey showed significant concentrations of the 1982 year-class in all areas. No catch rate data were available from the commercial fishery. Catch rates from the research gillnet program showed a slight decline from 1984 to 1985. Cohort analysis was not conducted because reliable estimates of partial recruitment and terminal fishing mortality could not be calculated. Biomass estimates and population numbers at age were calculated from the acoustic purse seine surveys for each of the last three years. Projections were made to 1987 assuming a fixed catch in 1986. Management considerations are also presented.

Resume

L'analyse des données de 1985 est présentée pour les trois complexes de stocks de harengs de la côte est de Terre-Neuve : 1) baie Blanche-baie Notre-Dame, 2) baie Bonavista-baie de la Trinité et 3) baie de la Conception-côte sud. Les débarquements des pêches commerciales, limitées au filet maillant étaient d'environ 2 500 t. Comme en 1984, c'est la classe d'âge de 1979 qui dominait la pêche commerciale. Les échantillons prélevés dans le cadre du programme de recherche sur la pêche au filet maillant montraient une augmentation dans les prises de la classe d'âge de 1982. De même, le dénombrement acoustique à la senne coulissante montrait des concentrations importantes de la classe d'âge de 1982 dans toutes les régions. La pêche commerciale n'a fourni aucune donnée sur le taux de capture. Les taux de capture obtenus dans le cadre du programme de recherche sur la pêche au filet maillant étaient légèrement inférieurs en 1985 à ceux de 1984. L'analyse des cohortes n'a pas été faite car les estimations fiables du recrutement partiel et du F_t (taux instantané de mortalité par pêche de la dernière année) n'avaient pu être faites. L'estimation de la biomasse et le dénombrement de la population par âge ont été calculés à partir des dénombrements acoustiques à la senne coulissante pour chacune des trois dernières années. En supposant des prises fixes en 1986, on a fait des projections pour 1987. Des considérations de gestion sont aussi présentées.

Introduction

A) Description of the Fishery

In 1985, the east coast Newfoundland herring fishery was restricted to gillnets only. The spring fishery commenced April 1 and terminated June 16 in all areas with the exception of Trinity Bay and part of Notre Dame Bay (North Head to Dog Point) where the fishery was closed May 23 due to quota overruns. The fall fishery commenced September 16 in all areas except White Bay (Cape Bauld to Harbour Deep) where it opened August 12. The fishery continued in all areas until December 31. Allocations by stock area and season were as follows:

Stock area	Spring fishery	Fall fishery
White Bay-Notre Dame Bay (WB-NDB)	1000 t	1000 t
Bonavista Bay-Trinity Bay (BB-TB)	400 t	400 t
Conception Bay-Southern Shore (CB-SS)	100 t	100 t

B) Nominal Catches

TAC's and landings ($x10^3$ t) are listed below for 1978 to 1985.

		1978	1979	1980	1981	1982	1983	1984	1985
WB-NDB	TAC	7.9	11.5	5.3	3.5	1.2	0.0	1.5	2.0
	Catch	13.4	15.7	6.5	4.7	2.0	0.4	1.5*	1.8*
BB-TB	TAC	7.8	8.4	4.4	3.2	0.7	0.0	0.4	0.8
	Catch	8.0	9.8	5.4	4.0	0.5	0.1	0.2*	0.6*
CB-SS	TAC	1.8	0.9	0.4	0.3	0.2	0.0	0.1	0.2
	Catch	1.9	0.9	0.5	0.2	0.1	0.1	0.1*	0.1*

* preliminary

C) Anecdotal Information

East coast Newfoundland herring stock areas have been delineated from the results of tagging experiments conducted from 1975 to 1981 (Wheeler and Winters 1984) and include three stock complexes (Fig. 1): 1) White Bay-Notre Dame Bay (3Ka, 3Kd, 3Kh, and 3Ki), 2) Bonavista Bay-Trinity Bay (3La and 3Lb), and 3) Conception Bay-Southern Shore (3Lf and 3Lj).

The history of the modern commercial fishery in the area consists of approximately 6-7 years, from 1974 with the introduction of large (>65 ft) mobile purse seiners to 1981 when the fishery was closed to the mobile fleet, which by then consisted of smaller (<65 ft) ringnet vessels. The traditional fishery was by fixed gear, and prior to the 1970's average annual landings were <2000 t. However, throughout the 1970's, with the recruitment of the very large 1968 year-class and the availability of markets due primarily to the collapse of the

North Sea stocks, gillnet landings increased rapidly to a maximum of 13,000 t in 1979 (Tables 1-3). TAC's were first introduced to the ringnet fleet in 1977, the same year that the large purse seine vessels were excluded from the fishery. Gillnets came under quota control in 1980 at a time when the fishery was being restricted due to poor recruitment. Stocks continued to decline during the early 1980's. The ringnet fishery was closed in 1982, likewise the entire fishery in 1983 with the exception of a limited fixed gear bait fishery. Despite CAFSAC advice that the fishery remain closed in 1984 and 1985, a limited fixed gear fishery was allowed. With the exception of minor overruns in some areas, the TAC was not taken in either year. This was due primarily to market constraints, the price paid to fishermen (approximately $0.05/lb) being too low to make the fishery viable.

INPUT DATA

A) Biological Sampling

The number of herring sampled in 1985, from the commercial fishery and research programs, was 11,646 (Table 4). This represented a decrease of 6% from 1984. However, when apportioned by stock area, month, and gear type (Table 5), samples were available for 97% of the commercial catch. Samples were collected randomly; all fish sampled were measured and aged.

Mean weights at age for 1985 (Table 6) were derived from samples of spring spawning herring collected from January to June. Both commercial and research samples were used in these calculations.

B) Commercial Fishery Data

Commercial catch-at-age data (Tables 7-9) were generated for each stock area by applying age compositions from the appropriate commercial samples to the landings. However, similar to previous years, in certain cases, research samples collected from commercial mesh size (2 1/2" and 2 3/4") gillnets were used to generate catch-at-age data where no commercial samples were available. The 1984 catch matrix was adjusted to include updated catch statistics. However, the values for both 1984 and 1985 are preliminary as final catch statistics are not available.

As in 1984, fish of the 1979 year-class and fish ages 11+ dominated the commercial fishery representing approximately 75% of the catch (by number) in White Bay-Notre Dame Bay and Bonavista Bay-Trinity Bay and 60% in Conception Bay-Southern Shore (Fig. 2). The 1982 year-class was caught for the first time in 1985, accounting for approximately 5% of the catch in White Bay-Notre Dame Bay, 10% in Bonavista Bay-Trinity Bay and 20% in Conception Bay-Southern Shore. As in previous years, percentages of autumn spawners increased from north to south. The percent of autumn spawners in the catch decreased slightly from 1984 consistent with the predominance of spring spawners in the 1982 year-class.

No commercial catch-rate data were available in 1985.

C) Research Survey Data

i) Acoustic Purse Seine Survey

For the fourth consecutive year, two commercial purse seine vessels (<65 ft) were chartered for five weeks in October-November 1985. The survey commenced in White Bay and proceeded southward through Notre Dame Bay, Bonavista Bay and Trinity Bay (Appendices 1-11). Upon termination of the charter, the research vessel MARINUS continued the acoustic survey through Trinity Bay and Conception Bay (Appendices 12-15). 1734 kilometers were effectively surveyed during 196 hours (Table 10); horizontal and vertical dimensions of 1575 herring schools were measured from sounder tracings during the survey. Effective cruise track distances for 1983 and 1984 have been recalculated to correct for the conversion from nautical miles to kilometers.

There were 11 successful sets during the 1985 survey (Appendix 16), a reduction of 75% from 1984. The 1982 and 1983 year-classes predominated in the successful sets. The reduction in the number of successful sets in 1985 occurred because most schools were deeper in the water column and hence less available to the purse seines. It was felt throughout the survey that the sampling may have been biased toward the 1983 year-class as schools of these fish were found higher in the water column.

Anchor tags were applied to 1982 and 1983 year-class herring in seven locations during the 1985 survey (Appendix 17). Results of the experiments will further elucidate the migratory patterns of these juvenile herring.

Age compositions of herring from the acoustic purse seine survey (Fig. 3) show the dominance (by number) of the 1982 and 1983 year-classes. In White Bay-Notre Dame Bay the year-classes are of equal strength; in Bonavista Bay-Trinity Bay the 1983 year-class is approximately half that of the 1982 year-class. These percentages have been weighted to account for abundance differences in subareas (i.e. grids) within the stock areas. Autumn spawners have been excluded as they represented <5% of the samples taken.

ii) Research Gillnet Program

For the sixth consecutive year, commercial fishermen fished research gillnets for a period of one month during the spring or fall. In 1985, 16 east coast fishermen (see Fig. 1 for locations) were each contracted to fish a fleet of five gillnets, mesh sizes 2", 2 1/4", 2 1/2", 2 3/4", and 3", to maintain an accurate daily log record of catches and to collect and freeze samples of their catch.

The age compositions of the research gillnet catches (Fig. 4 and Appendices 18-22) were calculated by applying age distributions of samples taken during the month, normally at four-day intervals, to catches during that interval and then combining these interval age distributions to obtain one for the entire month. In White Bay-Notre Dame Bay, the 1982 year-class represented 35% of the catch (by number), in Bonavista Bay-Trinity Bay 50%

and in Conception Bay-Southern Shore 70%. These proportions represented an increase from 1984. Relative to catches of the 1982 year-class in 1984, the 1983 year-class did not show strongly in the research gillnet catches in 1985. The percentage of 1982 year-class in the catch increased from north to south as it did in the commercial catch. The relative contribution of the 1979 year-class decreased from 1984 to 1985 as did the percentage of autumn spawners both of which are consistent with the recruitment of the strong 1982 year-class.

Two catch-per-unit-effort indices were calculated from the research gillnet program: 1) number of herring caught per fishing day, and 2) number of herring caught per days hauled (Tables 11-13). In some cases (marked with asterisks), due to a change in the depth of nets provided to certain fishermen in 1980-82, total catch and hence catch rates had to be adjusted before comparisons could be made. The adjustment factor, (Deep = 2.75 x Shallow) was derived from comparisons of catches from experiments with both shallow (old) and deep (new) nets conducted from 1983 to 1985 (Table 14).

In White Bay-Notre Dame Bay, catch rates have declined slightly from 1984 to 1985. In Bonavista Bay-Trinity Bay, the decrease was more pronounced. However, in Conception Bay, the trend was reversed as the catch rate doubled from 1984 to 1985. The decreasing trend in catch rates may be explained by a relatively weak 1979 year-class plus declining abundance of older fish (primarily 1968 year-class) both of which were important components of the research gillnet catches over the past two to three years. The impact of the 1982 year-class will not be fully felt until 1986 when it is fully recruited to these gears.

Minor changes in the total catches and effort values (Tables 11-13) from last year, are the result of recent computerization and standardization in methods of analysis. The results of the research gillnet program will be thoroughly reviewed within the next year to examine the considerable variability between fishermen.

D) Estimation of Parameters

In determining partial recruitment rates (Table 15), an attempt was made to empirically assess the younger age groups, in particular the 1982 year-class. The population numbers at age, derived from the acoustic purse seine survey (see Assessment Results - Section A) were compared with the commercial catch at age and the ratios that were derived were normalized to give partial recruitment patterns. However, because the population numbers at age in 1985 may be biased due to the sampling problems in the acoustic survey, it was felt that results of this method may also be biased.

Instantaneous total mortality estimates (Paloheimo 1961) were calculated for ages 4+ for each of the research gillnet catch rate series (Tables 16 and 17). Age 4+ was chosen after examination of the catch-at-age data from the research gillnet program (Appendices 18-22) and the mesh selectivity of the various sized

nets. From these data it appeared that full recruitment to the research gillnets occurred at age 4+. It was impossible to discern any trends in Z values due to the variability within the data.

ASSESSMENT RESULTS

A) Biomass Calculation from Acoustic Survey

The survey was designed such that each of the two vessels covered a separate cruise track, primarily within the 90 m contour. Only those times when the vessel was actively searching were included in estimating the length of the cruise track. Accurate records of vessel speed were kept for this purpose. The cruise track width was estimated as the lateral distance swept by the sonar while searching (0.304 km). It was therefore possible to accurately estimate the square area surveyed (km^2) within each stock area.

The vessel used its sonar to locate schools within the cruise track. Single line transects of each school would then be marked on the sounder paper. Horizontal and vertical dimensions of each school were subsequently measured. School depth was measured directly from the sounder scale; the horizontal dimension was converted from "mm" on the sounder to meters by relating sounder paper speed (sec/mm) to vessel speed (m/sec). The number of schools recorded on the sounder was considered to be a conservative estimate as not all schools observed by sonar within the cruise track were recorded on the sounder.

During the 1984 acoustic purse seine survey, and again in 1985, a relationship was calculated (Fig. 5) between cross-sectional area of schools (m^2) and weight per school (kg) as visually estimated from purse seine sets in shallow water (<30 m) where it was considered that the entire school had been caught. The maximum school size that can be accurately predicted within this relationship is approximately 25 t. During the 1985 survey, 86% of the schools measured, which represented approximately 30% of the observed biomass, were within this range. A pattern exists in the residuals for larger school sizes suggesting that estimates of these schools will be biased downward.

The relationship between school area and school size was applied to each of the schools measured during the survey to obtain an estimate of tons observed within each bay (Table 18). Tons per km^2 surveyed were then calculated. These density estimates were prorated by areal expansion to give biomass estimates within the 90 m contour, considered to be the extent of stock range. Since a number of schools were observed outside the 90 m contour, these biomass estimates are considered to be conservative. Estimates for 1983 and 1984 differ from those presented last year as corrections have been made both to "tons observed" and "km^2 surveyed". The "tons observed" now consists of estimates of individual school sizes as opposed to mean school size estimates as presented last year. The area surveyed has been corrected to account for the conversion from nautical miles to km.

Prior to the acoustic survey, each stock area was divided into smaller subareas or grids (Fig. 6). The observed biomass was calculated for each of these

grids (Tables 19-20). Ideally, a biomass estimate within the 90 m contour should be calculated for each of these grids and then these individual estimates combined to determine stock biomass. However, an accurate estimation of stock area in each grid has not yet been calculated and therefore the biomass has not been apportioned.

In calculating population numbers at age (Tables 19 and 20), estimates were weighted by the observed biomass within each of the sampled grids. The observed biomass was apportioned into spring and autumn spawning components based on percentages within the purse seine samples. Autumn spawners were deleted from further analysis as they represented less than 5% of the sample numbers. The observed spring spawner biomass was converted to numbers by applying the mean sample weight. The total observed numbers were apportioned into numbers at age by the age composition of the sample. The observed numbers at age within each grid were combined and adjusted to include those grids in which no samples were taken. This provided predicted numbers at age within the cruise track which in turn were adjusted to give stock numbers at age within the 90 m contour. For Bonavista Bay-Trinity Bay, grid 11 was treated separately from the other grids as it appeared to represent a "nursery area" of 0 age group fish and to have included it with the other subareas would have given a biased estimate of 0 age group fish for the stock.

Population numbers at age as calculated above are summarized in Table 21. As there were no biomass estimates for the White Bay portion of the White Bay-Notre Dame Bay stock in 1983 and 1984, the ratio of observed biomass between White Bay and Notre Dame Bay in 1985 was used to predict estimates in these years. Similarly, Trinity Bay biomass in 1983 was estimated from the ratio of observed biomass in Bonavista Bay to Trinity Bay in 1984 and 1985.

Age compositions, and hence population numbers at age, were not available for Conception Bay-Southern Shore from the acoustic survey because no sets were make in this area.

The acoustic surveys have now provided three estimates of the 1982 year-class (Table 21). For White Bay-Notre Dame Bay, the estimates at age 2 (adjusted to January 1984) are: 550 x 10^6 from the 1983 survey, 750 x 10^6 from the 1984 survey, and 900 x 10^6 from the 1985 survey. Similarly, for Bonavista Bay-Trinity Bay, the estimates at age 2 are 625 x 10^6, 400 x 10^6, and 380 x 10^6.

The 1983 year-class also appears to be stronger than other recent year-classes, approximately 64-95% that of the 1982 year-class at age 2 in White Bay-Notre Dame Bay and 18-39% that of the 1982 year-class in Bonavista Bay-Trinity Bay.

As stated before, it was felt that sampling during the 1985 survey may have been biased toward the 1983 year-class. If so, then the mean sample weight should be higher and population numbers should be slightly lower. Similarly, the numbers at age 2 (1983 year-class) in 1985 should be lower.

There are several sources of uncertainty in the calculation of stock biomass from the purse seine surveys which may produce either negative or positive biases in the results. These will have to be examined in more detail prior to the next assessment.

The relationship between cross-sectional areas of schools and weight per school assumes that the single line transect is through the widest lateral dimension of the school and that there is symetry to the school. For larger schools, it is difficult to ensure that the school is crossed on its widest axis. The impact of this when determining the relationship is uncertain; however, the relationship (Fig. 5), as derived, suggests that the weight of larger schools may be underestimated.

The cruise track width may be underestimated as schools which are detected and measured at the outermost lateral edge of the track would increase the effective width of the search pattern. The effect of changing vessel course to measure these schools is uncertain, as schools on the original course may be undetected.

It is also difficult to determine the effect of calculating population age compositions using the overall stock area estimate rather than from a summation of grid biomasses as the effect depends on whether there are different densities of herring in larger or smaller grids.

B) Cohort Analysis

Cohort analysis was not conducted for these stocks because reliable estimates of partial recruitment values and terminal fishing mortality could not be calculated.

PROGNOSIS

A) Catch Projections

The population numbers for the 1982 and 1983 year-classes from the 1984 acoustic purse seine survey were used in projections for White Bay-Notre Dame Bay and Bonavista Bay-Trinity Bay. These numbers were considered more reliable than the 1985 estimates because of the availability problems and lower sampling rate encountered during the 1985 survey. They are also not markedly different from the averages of the three surveys. The 1982 and 1983 year-class population numbers were considered to represent the future fishable population and without strong recruitment these year-classes will form the basis of the commercial fishery in the coming years.

The population numbers were projected to 1987 assuming the following catches in 1986:

Area	TAC (t)
White Bay-Notre Dame Bay	5500
Bonavista Bay-Trinity Bay	3800

These catches were assumed reasonable as they form the basis of the 1986 Herring Management Plan. They may represent maximum catches depending on market availability. The population numbers, used to initiate the projections in 1986 were corrected to allow for natural mortality from the time of the acoustic survey to the beginning of 1986. Mean weights at age were those derived from samples collected in 1985 (Table 6). Natural mortality was assumed to be 0.20 and $F_{0.1}$ to be 0.30. Recruitment at age 2 was assumed to be zero. The following partial recruitment pattern based upon a historical combined purse seine and gillnet fishery (Winters and Moores 1977) was used in the projection.

Age	2	3	4	5+
P.R.	0.10	0.35	0.60	1.00

These projections are presented in Table 22.

While the biomass estimate from the acoustic survey for Conception Bay-Southern Shore was very low (541 t), differences in the way it was derived (research vs commercial vessel) preclude direct comparisons with surveys in other areas. Given the apparent recruitment of the 1982 year-class to the research gillnets in Conception Bay, it may be appropriate to consider historical relationships. In previous assessments of these stocks where cohort analysis has been performed (Wheeler et al. 1985, Wheeler et al. 1984), biomass (2+) estimates of the Conception Bay-Southern Shore stock have been approximately 25% that of the adjacent Bonavista Bay-Trinity Bay stock. Given the apparent parallelism in the recruitment to these herring stocks, a similar relationship may still be appropriate.

Illustrative projections have been made to 1992 for White Bay-Notre Dame Bay and Bonavista Bay-Trinity Bay (Tables 23 and 24) with the same population numbers, mean weights at age and recruitment values and partial recruitment pattern as used above. As these herring stocks are at the northernmost edge of their range, strong recruitment tends to be very sporadic, 14 years between the 1968 and 1982 year-classes. To help compensate for this sporadic strong recruitment, projections have been made assuming two levels of fishing mortality, F = 0.30 and F = 0.20. Projections have also been made to illustrate the effect of implementing different annual catch levels.

B) Management Implications

Similar to last year, projections have been based entirely upon population estimates derived from the acoustic survey. This technique shows excellent potential as it is independent of the commercial fishery and provides estimates of year-class size prior to their recruitment to the fishery. Although refinements have been made from last year, the estimates are still very preliminary and further analysis is required, in particular with regard to the relationship

between school size and school weight and other sources of uncertainty. A comparative survey, involving more sophisticated hydroacoustic techniques to estimate school size and density, would provide more information on this relationship.

The short term future of the Newfoundland herring stocks looks secure with the recruitment of the 1982 year-class. The long term future depends both upon management practices and recruitment success. It is important that, from a biological point of view, fishing effort should be directed towards the spring spawners on or near spawning grounds. Fall fisheries, which exploit mixed stocks, have the potential to destroy a particular spawning group. Spring fisheries, on or near the spawning grounds, if regulated properly, will ensure continued viability of all spawning stock components.

Acknowledgment

We would like to thank all technical staff who were involved in the herring research program, M. F. Dawson who administered the research gillnet program in an excellent manner, P. J. Williams who provided our best sampling coverage ever, to all our samplers, and special thanks to our typist, M. Y. Hynes.

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Table 1. White Bay (W.B.) - Notre Dame Bay (N.D.B.) herring landings (t), by gear, 1973-85.

YEAR	AREA	GEAR						TOTAL
		PURSE SEINE	RING NET	MDWTR TRAWL	BAR SEINE	GILL NET	TRAP	
1973	W.B.	1	-	-	35	552	229	817
	N.D.B.	1	-	-	20	1533	105	1659
	Combined	2	-	-	55	2085	334	2476
1974	W.B.	-	8	11	53	738	632	1442
	N.D.B.	-	6	-	85	2191	312	2594
	Combined	-	14	11	138	2929	944	4036
1975	W.B.	828	-	-	46	1209	329	2412
	N.D.B.	1183	108	-	12	1631	209	3143
	Combined	2011	108	-	58	2840	538	5555
1976	W.B.	1724	487	-	18	509	246	2984
	N.D.B.	2908	3412	-	589	2242	353	9504
	Combined	4632	3899	-	607	2751	599	12488
1977	W.B.	-	1228	-	39	268	240	1775
	N.D.B.	-	4961	-	2096	2438	355	9850
	Combined	-	6189	-	2135	2706	595	11625
1978	W.B.	-	1254	-	240	1133	331	2958
	N.D.B.	-	3980	-	306	5859	311	10456
	Combined	-	5234	-	546	6992	642	13414
1979	W.B.	-	832	-	9	978	64	1883
	N.D.B.	-	1968	-	2274	8971	598	13811
	Combined	-	2800	-	2283	9949	662	15694
1980	W.B.	-	747	-	-	1269	83	2099
	N.D.B.	-	913	-	727	2778	13	4431
	Combined	-	1660	-	727	4047	96	6530
1981	W.B.	-	220	-	14	646	23	903
	N.D.B.	-	1065	-	400	2209	107	3781
	Combined	-	1285	-	414	2855	130	4684
1982	W.B.	-	-	-	7	402	52	461
	N.D.B.	-	-	-	136	1425	1	1562
	Combined	-	-	-	143	1827	53	2023
1983	W.B.	-	15	-	-	76	7	98
	N.D.B.	-	-	-	-	329	-	329
	Combined	-	15	-	-	406	7	427
1984*	W.B.	-	-	-	4	339	4	347
	N.D.B.	-	-	-	3	1115	-	1118
	Combined	-	-	-	7	1454	4	1465
1985*	W.B.	-	-	-	3	562	-	565
	N.D.B.	1	-	-	9	1247	-	1257
	Combined	1	-	-	12	1809	-	1822

* provisional

Table 2. Bonavista Bay (B.B) - Trinity Bay (T.B.) herring landings (t), by gear, 1973-85.

YEAR	AREA	GEAR						TOTAL
		PURSE SEINE	RING NET	MDWTR TRAWL	BAR SEINE	GILL NET	TRAP	
1973	B.B.	5	-	-	23	479	2	509
	T.B.	156	-	-	199	340	5	700
	Combined	161	-	-	222	819	7	1209
1974	B.B.	-	-	-	21	611	10	642
	T.B.	-	428	-	154	976	93	1651
	Combined	-	428	-	175	1587	103	2293
1975	B.B.	1559	-	-	34	414	2	2009
	T.B.	1370	1790	-	242	411	90	3903
	Combined	2929	1790	-	276	825	92	5912
1976	B.B.	2812	3052	-	24	328	139	6355
	T.B.	1614	1054	-	465	419	30	3582
	Combined	4426	4106	-	489	747	169	9937
1977	B.B.	-	6223	236	2495	309	-	9263
	T.B.	-	1548	-	927	174	45	2694
	Combined	-	7771	236	3422	483	45	11957
1978	B.B.	-	4239	-	150	1320	3	5712
	T.B.	-	1055	-	966	308	8	2337
	Combined	-	5294	-	1116	1628	11	8049
1979	B.B.	-	3490	-	377	2374	4	6245
	T.B.	-	1181	-	1615	680	55	3531
	Combined	-	4671	-	1992	3054	59	9776
1980	B.B.	-	1714	-	652	1321	-	3687
	T.B.	-	964	-	405	336	13	1718
	Combined	-	2678	-	1057	1657	13	5405
1981	B.B.	-	1100	-	713	1399	7	3219
	T.B.	-	78	-	361	367	19	825
	Combined	-	1178	-	1074	1766	26	4044
1982	B.B.	-	-	-	-	386	4	390
	T.B.	-	-	-	25	76	6	107
	Combined	-	-	-	25	462	10	497
1983	B.B.	-	-	-	-	52	-	52
	T.B.	-	-	-	27	17	-	44
	Combined	-	-	-	27	69	-	96
1984*	B.B	-	-	-	-	135	-	135
	T.B.	-	-	-	-	41	-	41
	Combined	-	-	-	-	176	-	176
1985*	B.B.	-	-	-	3	263	2	268
	T.B.	-	-	-	2	309	6	317
	Combined	-	-	-	5	572	8	585

* provisional

Table 3. Conception Bay (C.B.) - Southern Shore (S.S.) herring landings (t), by gear, 1973-85.

YEAR	AREA	GEAR						TOTAL
		PURSE SEINE	RING NET	MDWTR TRAWL	BAR SEINE	GILL NET	TRAP	
1973	C.B.	211	-	-	491	181	83	966
	S.S.	18	-	-	157	170	-	345
	Combined	229	-	-	648	351	83	1311
1974	C.B.	48	2107	-	67	131	134	2487
	S.S.	-	32	-	14	72	86	204
	Combined	48	2139	-	81	203	220	2691
1975	C.B.	13	2281	-	388	166	24	2872
	S.S.	315	-	-	23	160	169	667
	Combined	328	2281	-	411	326	193	3539
1976	C.B.	-	1704	258	76	153	92	2283
	S.S.	-	44	-	-	8	149	201
	Combined	-	1748	258	76	161	241	2484
1977	C.B.	-	1248	-	58	174	12	1492
	S.S.	-	442	-	-	18	200	660
	Combined	-	1690	-	58	192	212	2152
1978	C.B.	-	1098	-	11	415	3	1527
	S.S.	-	133	-	14	78	193	418
	Combined	-	1231	-	25	493	196	1945
1979	C.B.	-	432	-	-	210	63	705
	S.S.	-	10	-	18	49	111	188
	Combined	-	442	-	18	259	174	893
1980	C.B.	-	319	-	16	107	1	443
	S.S.	-	-	-	-	2	32	34
	Combined	-	319	-	16	109	33	477
1981	C.B.	-	-	-	-	160	2	162
	S.S.	-	-	-	-	53	8	61
	Combined	-	-	-	-	213	10	223
1982	C.B.	-	-	-	-	84	1	85
	S.S.	-	-	-	-	7	5	12
	Combined	-	-	-	-	91	6	97
1983	C.B.	-	-	-	-	17	-	17
	S.S.	-	-	-	-	-	-	-
	Combined	-	-	-	-	17	-	17
1984*	C.B.	-	-	-	-	50	-	50
	S.S.	-	-	-	-	-	-	-
	Combined	-	-	-	-	50	-	50
1985*	C.B.	-	-	-	-	81	-	81
	S.S.	-	-	-	-	15	-	15
	Combined	-	-	-	-	96	-	96

* provisional

Table 4. Number of fish sampled from the northeast Newfoundland herring fishery, by area and gear, 1981-85 (research samples in parentheses).

CATCH YEAR	AREA	GEAR TYPE: TRAP	BAR SEINE	GILLNET	RINGNET	TOTAL SAMPLED	COMM. (t)
1981	WB	-	-	(598)	-	(598)	903
	NDB	-	498	549(1576)	1369	2416(1576)	3781
	BB	-	450 (150)	450 (731)	1545 (550)	2445(1431)	3219
	TB	-	398	200 (400)	350	948 (400)	825
	CB	-	-	-	-	-	162
	SS	-	-	-	-	-	61
	TTL.	-	1346 (150)	1199(3305)	3264 (550)	5809(4005)	8951
1982	WB	196	-	(1133)	-	196(1133)	461
	NDB	-	150	1000	(1022)	1150(1022)	1562
	BB	-	-	850(1378)	(2202)	850(3580)	390
	TB	-	-	10 (381)	-	10 (381)	107
	CB	-	-	100	-	100	85
	SS	-	-	-	-	-	12
	TTL.	196	150	1960(2892)	(3224)	2306(6116)	2617
1983	WB	-	63	376 (799)	22	461 (799)	98
	NDB	-	-	(1230)	200(2927)	200(4157)	330
	BB	700	-	645(1210)	(2065)	1345(3275)	54
	TB	527	-	548 (678)	(700)	1075(1378)	44
	CB	326	-	50 (145)	(450)	376 (595)	17
	SS	150	-	-	-	150	-
	TTL.	1703	63	1619(4062)	222(6142)	3607(10204)	543
1984	WB	121	-	825(1207)	-	946(1207)	347
	NDB	-	50	2116(1150)	(664)	2166(1814)	1118
	BB	-	-	550(1860)	(844)	550(2704)	135
	TB	150	(100)	200 (800)	(700)	350(1600)	41
	CB	(100)	-	50 (400)	(464)	50 (964)	50
	SS	-	-	-	-	-	-
	TTL.	271 (100)	50 (100)	3741(5417)	(2672)	4062(8289)	1691
1985	WB	175	-	580(1047)	-	755(1047)	565
	NDB	-	100	994(1200)	(237)	1094(1437)	1257
	BB	-	-	1048(2036)	(350)	1048(2386)	268
	TB	-	-	536(1000)	(317)	536(1317)	317
	CB	26	-	450 (800)	(150)	476 (950)	81
	SS	-	-	100 (500)	-	100 (500)	15
	TTL.	201	100	3708(6583)	(1054)	4009(7637)	2503

Table 5. Commercial catch (t) and sampling (number of fish) for 1985, by stock area, month and gear type.

		WB-NDB		BB-TB		CB-SS	
MONTH	GEAR	CATCH (t)	NO. SAMPLED	CATCH (t)	NO. SAMPLED	CATCH (t)	NO. SAMPLED
APRIL	GILLNET	15	-	159	350	26	116
	TRAP	-	-	1	-	-	-
MAY	GILLNET	540	250	242	827	32	513
	TRAP	-	-	4	-	-	-
JUNE	GILLNET	278	250	81	100	3	106
	TRAP	-	-	3	-	-	-
JULY	GILLNET	37	300	2	-	4	-
AUGUST	GILLNET	5	294	-	-	-	-
SEPTEMBER	GILLNET	141	417	12	100	3	50
	BAR SEINE	1	-	2	-	-	-
OCTOBER	GILLNET	622	838	38	453	5	73
	BAR SEINE	2	100	-	-	-	-
NOVEMBER	GILLNET	171	84	20	574	17	147
	BAR SEINE	9	-	1	-	-	-
DECEMBER	GILLNET	-	-	18	150	6	221
	BAR SEINE	-	-	2	-	-	-
COMBINED	GILLNET	1809	2433	572	2554	96	1226
	TRAP	-	-	8	-	-	-
	BAR SEINE	12	100	5	-	-	-

Table 6. Mean weight at age (g) of east coast Newfoundland herring from samples collected January - June, 1985. Sample sizes in parentheses.

AGE	STOCK AREA		
	WB-NDB	BB-TB	CB-SS
2	-	-	-
3	-	118 (327)	114 (29)
4	197 (34)	199 (88)	196 (7)
5	262 (22)	234 (66)	249 (28)
6	263 (147)	274 (41)	276 (62)
7	300 (9)	301 (22)	310 (13)
8	325 (30)	343 (24)	336 (9)
9	332 (5)	339 (19)	357 (5)
10	353 (12)	365 (20)	370 (3)
11+	376 (184)	393 (882)	399 (455)

Table 7. Commercial catch at age of spring spawning herring for White Bay - Notre Dame Bay, 1966-1985.

AGE	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	1	86	1	1	10	1	5	1	1	2
3	40	43	64	54	1	303	292	728	5	128
4	2	1551	1	103	13	51	2448	1494	119	216
5	27	86	718	19	24	159	362	2928	3177	460
6	67	43	11	1155	25	57	70	775	5523	5458
7	180	1	48	1	988	431	126	734	1198	7090
8	128	86	161	108	11	10134	408	663	705	1123
9	23	1	295	9	86	235	1391	419	1511	836
10	6	1	188	59	161	278	208	1695	861	809
11	75	6	1	27	167	1139	67	162	1595	1072
12	1	80	6	1	76	1181	275	52	152	1986
13	1	1	84	1	3	537	285	214	49	189
14	1	1	1	12	3	21	130	222	201	61
15	1	1	1	1	34	21	5	101	209	250
16	1	1	1	1	1	240	5	4	95	260
17	1	1	1	1	1	1	58	4	4	118
18	1	1	1	1	1	1	1	45	4	5
19	1	1	1	1	1	1	1	1	42	5
20	1	1	1	1	1	1	1	1	1	52
AGE	1976	1977	1978	1979	1980	1981	1982	1983	1984*	1985*
2	121	52	1	1	115	445	76	1	6	3
3	32	1704	55	53	46	152	371	38	12	187
4	611	109	2041	712	1240	41	332	46	123	350
5	245	468	318	869	92	1231	59	23	1217	240
6	815	184	1037	647	1080	63	268	14	72	1485
7	10280	795	518	1049	17	805	34	93	114	108
8	16377	7391	2514	2097	496	64	258	1	157	275
9	1295	12697	10820	6606	179	344	19	26	37	94
10	3304	1055	11773	14213	1449	194	192	4	121	80
11	1391	4488	906	11164	5335	982	71	36	10	124
12	1843	1890	3854	859	4191	3614	359	13	86	10
13	3414	2504	1623	3655	322	2839	1312	68	31	88
14	325	4638	2150	1539	1372	218	1038	249	163	32
15	105	441	3983	2039	578	929	80	197	596	167
16	430	143	379	3777	765	392	340	15	472	610
17	447	584	123	359	1418	518	143	65	36	483
18	203	607	502	117	135	961	189	27	156	37
19	9	276	521	476	44	91	351	36	65	160
20	98	145	362	837	493	364	166	98	321	395

* preliminary

Table 8. Commercial catch at age of spring spawning herring for Bonavista Bay - Trinity Bay, 1966-1985.

AGE	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	1	35	1	1	1	1	1	1	1	1
3	33	17	42	6	1	416	10	2	1	396
4	15	628	1	4	10	226	1354	78	2	136
5	9	35	469	10	10	21	390	3632	236	164
6	83	17	7	332	57	18	91	380	4848	2577
7	96	1	32	4	867	200	76	63	440	14373
8	179	35	105	52	37	1042	90	80	152	456
9	32	1	193	27	135	129	486	107	301	1002
10	40	1	123	38	74	128	14	756	69	729
11	300	4	2	197	26	69	68	15	581	139
12	1	31	7	3	135	24	37	73	12	1170
13	1	1	52	11	2	125	13	40	56	24
14	1	1	1	83	8	2	66	14	31	113
15	1	1	1	1	57	7	1	71	11	62
16	1	1	1	1	1	53	4	1	55	22
17	1	1	1	1	1	1	28	4	1	111
18	1	1	1	1	1	1	1	30	3	2
19	1	1	1	1	1	1	1	1	23	6
20	1	1	1	1	1	1	1	1	1	46

AGE	1976	1977	1978	1979	1980	1981	1982	1983	1984*	1985*
2	14	17	22	6	15	136	1	1	4	10
3	77	248	26	286	13	246	8	4	22	158
4	495	135	358	167	195	53	11	34	35	63
5	122	762	115	763	43	256	2	7	210	84
6	167	227	242	19	294	26	30	2	9	333
7	4936	50	112	433	52	288	5	15	5	36
8	20812	6202	588	101	264	23	35	1	12	26
9	912	23061	4275	503	75	321	5	8	2	13
10	860	952	13035	5565	967	88	65	2	2	22
11	1303	966	790	13898	2680	860	9	8	2	10
12	248	1463	801	841	6693	2383	86	1	8	10
13	2092	279	1214	853	405	5952	239	11	1	39
14	43	2349	231	1292	411	360	596	30	11	5
15	202	48	1949	246	622	366	36	76	29	53
16	111	227	40	2075	118	553	37	5	73	141
17	39	125	188	43	999	105	55	5	5	354
18	198	44	104	200	21	888	11	7	5	24
19	4	222	37	111	96	19	89	1	7	24
20	93	109	275	332	213	275	29	15	15	107

* preliminary

Table 9. Commercial catch at age of spring spawning herring for Conception Bay - Southern Shore, 1966-1985.

AGE	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	1	4	1	1	1	1	1	68	3	13
3	23	2	2	13	1	10	7	1	1	424
4	5	67	1	3	17	31	1625	23	5	30
5	1	4	17	2	20	13	135	4525	130	16
6	19	2	1	65	24	8	55	264	9544	2055
7	20	1	1	2	290	41	29	469	150	8816
8	125	4	4	1	14	308	79	136	75	116
9	28	1	7	1	15	33	359	40	40	492
10	1	1	5	2	12	13	67	188	13	256
11	126	1	1	3	14	10	22	8	584	17
12	1	4	1	1	20	12	17	3	25	773
13	1	1	1	1	7	17	21	2	9	33
14	1	1	1	1	7	6	29	3	6	12
15	1	1	1	1	7	6	10	4	9	8
16	1	1	1	1	1	6	10	1	12	12
17	1	1	1	1	1	1	10	1	3	16
18	1	1	1	1	1	1	1	1	3	4
19	1	1	1	1	1	1	1	1	3	4
20	1	1	1	1	1	1	1	1	1	4

AGE	1976	1977	1978	1979	1980	1981	1982	1983	1984*	1985*
2	1046	7	1	1	1	1	1	1	1	1
3	15	132	1	4	1	25	2	1	3	58
4	85	5	99	9	3	4	5	1	27	11
5	22	101	32	34	1	26	1	1	48	11
6	28	45	65	7	19	9	2	1	5	17
7	2364	13	14	38	1	28	1	1	1	2
8	4779	950	3	4	12	3	5	1	2	2
9	73	4260	735	31	1	14	1	1	1	1
10	226	49	3084	272	49	13	1	1	1	1
11	157	236	65	1144	156	21	4	1	1	7
12	10	164	315	24	656	68	7	1	1	7
13	475	10	219	117	14	288	23	1	1	7
14	20	496	13	81	67	6	98	2	1	7
15	7	21	663	5	46	29	2	7	3	7
16	5	7	28	246	3	20	10	1	1	22
17	7	5	9	10	141	1	7	1	1	7
18	10	7	7	3	6	62	1	1	1	7
19	2	10	9	3	2	3	21	1	1	7
20	5	7	23	12	9	5	3	2	1	15

* preliminary

Table 10. East coast Newfoundland acoustic purse seine survey parameters, 1983-85.

AREA	YEAR	SCHOOLS OBSERVED	KM SURVEYED	HRS SURVEYED
W.B.	1985	102	207	22.5
N.D.B.	1983	252	1114	116.3
	1984	595	849	114.8
	1985	633	970	95.1
B.B.	1983	210	726	103.3
	1984	851	1089	135.5
	1985	516	818	84.5
T.B.	1984	521	923	112.3
	1985	317	621	78.5
C.B.	1985	7	118	15.0

Table 11. Total catch (number of fish), number of days fished, number of days hauled, and catch rates for the research gillnet program, White Bay - Notre Dame Bay (* catch rates adjusted to account for shallow nets).

AREA	COMMUNITY	YEAR	TOTAL CATCH	DAYS FISHED	DAYS HAULED	CATCH/ DAYS FISHED	CATCH/ DAYS HAULED
WB	CROQUE	1984	1486	25	18	60	84
		1985	1151	29	20	40	58
	WESTPORT	1980	5962*	56	33	103*	181*
		1981	2835*	37	21	77*	135*
		1982	6474*	30	23	216*	281*
		1983	6991	31	25	226	280
		1984	11112	31	25	358	444
		1985	28211	31	22	910	1282
	BRENTS COVE	1982	19866	30	17	662	1169
		1983	27270	19	14	1420	1948
		1984	53915	30	18	1785	2962
		1985	9066	33	20	275	453
	LA SCIE	1980	17256*	26	18	664*	959*
		1981	4262	25	14	173	304
NDB	HARRY'S HARBOUR	1981	2395	29	18	81	135
		1983	34027	33	25	1031	1361
		1984	4881	33	24	148	203
		1985	7334	35	24	210	306
	LEADING TICKLES	1981	3528	33	20	107	176
		1983	10637	30	18	355	591
		1984	10642	30	18	355	578
		1985	25729	31	17	841	1513
	HILLGRADE	1980	104852*	59	37	1777*	2834*
		1981	7788*	32	17	243*	458*
		1982	0*	32	18	0*	0*
		1983	293	32	25	9	12
	HERRING NECK	1984	7890	31	23	255	343
		1985	5373	33	21	163	256
WB-NDB	COMBINED	1980	128070*	141	88	908*	1455*
		1981	20808*	156	90	136*	231*
		1982	26340*	92	58	286*	454*
		1983	79218	145	107	546	740
		1984	89926	180	126	500	713
		1985	76864	192	124	401	620

Table 12. Total catch (number of fish), number of days fished, number of days hauled, and catch rates for the research gillnet program, Bonavista Bay - Trinity Bay (* catch rates adjusted to account for shallow nets).

AREA	COMMUNITY	YEAR	TOTAL CATCH	DAYS FISHED	DAYS HAULED	CATCH/ DAYS FISHED	CATCH/ DAYS HAULED
BB	CENTREVILLE	1980	2720*	53	33	51*	82*
		1981	2280*	31	23	74*	99*
		1982	1404	27	19	52	74
		1983	1430	31	25	46	57
		1984	1754	31	23	57	76
		1985	3459	32	24	108	144
	SALVAGE	1980	11594*	33	22	351*	527*
		1981	633*	36	24	18*	26*
		1982	27944*	31	19	901*	1471*
		1983	19639	28	19	701	1034
		1984	11656	31	18	376	648
		1985	1819	30	18	61	101
	PORTLAND	1981	6734	28	19	237	354
		1982	3059	30	8	102	364
	CHARLOTTETOWN	1983	12660	37	25	339	515
		1984	5888	30	15	198	387
		1985	6666	32	18	208	370
	NEWMAN SD. (S)	1983	1229*	5	4	246	307
		1984	2157	8	7	270	308
		1985	1728	6	6	288	288
	NEWMAN SD. (F)	1984	199	11	9	18	22
		1985	440	8	8	55	55
TB	PORT REXTON	1982	1698	31	25	55	68
		1983	13435	32	23	420	584
		1984	6244	32	27	195	231
		1985	3233	32	24	101	134
	HICKMANS HARBOUR	1980	5891*	46	31	128*	190*
		1981	242*	31	26	8*	9*
		1982	424*	31	23	14*	18*
	LONG BEACH	1983	721	29	18	25	40
		1984	5205	33	22	158	237
		1985	1436	33	19	44	76
	CHANCE COVE (S)	1985	2083	32	18	65	116
BB-TB	COMBINED (S)	1983	1229*	5	4	246*	307*
		1984	2157	8	7	270	308
		1985	3811	38	24	100	159
	COMBINED (F)	1980	20204*	132	86	153*	235*
		1981	9888*	126	92	78*	107*
		1982	34412*	150	94	229*	366*
		1983	47885	157	110	304	436
		1984	30946	168	114	184	271
		1985	17043	167	111	102	154

Table 13. Total catch (number of fish), number of days fished, number of days hauled, and catch rates for the research gillnet program, Conception Bay - Southern Shore.

AREA	COMMUNITY	YEAR	TOTAL CATCH	DAYS FISHED	DAYS HAULED	CATCH/ DAYS FISHED	CATCH/ DAYS HAULED
CB	FOXTRAP (S)	1985	10515	33	20	319	521
	BAY ROBERTS (F)	1983	2442	30	12	81	207
		1984	22289	32	24	697	929
		1985	42453	31	19	1369	2234
SS	BURNT COVE (S)	1985	5949	28	11	216	531
	BURNT COVE (F)	1985	220	32	24	7	9
CB-SS	COMBINED (S)	1985	16464	61	31	272	524
	COMBINED (F)	1983	2442	30	12	81	207
		1984	22289	32	24	697	929
		1985	42673	63	43	677	992

Table 14. Comparative catch rates of shallow vs deep research gillnets, where total days fished is the same for both type nets.

	Community		No. caught per net 2"	2 1/4"	2 1/2"	2 3/4"	3"	Total caught	Conversion factor
White Bay	Westport	S	723	1027	1679	861	217	4507	1.55
	(Oct. '83)	D	1020	1691	2945	1007	325	6988	
Notre Dame Bay	Hillgrade	S	15	22	12	9	1	59	4.83
	(Oct. '83)	D	68	72	123	22	0	285	
Bonavista Bay	Salvage	S	436	795	710	418	166	2525	7.78
	(Oct. '83)	D	1755	4662	6745	4967	1510	19639	
Bonavista Bay	Newman Sd.	S	738	680	706	570	104	2798	0.77
	(May '84)	D	577	317	450	608	205	2157	
Bonavista Bay	Newman Sd.	S	39	50	16	15	0	120	1.98
	(Aug. '84)	D	38	57	79	47	17	238	
Bonavista Bay	Newman Sd.	S	566	484	100	194	73	1417	1.22
	(May '85)	D	481	363	458	142	284	1728	
Bonavista Bay	Newman Sd.	S	68	26	1	9	0	104	4.23
	(Aug. '85)	D	214	138	40	35	13	440	
Combined		S	2585	3084	3224	2076	561	11530	2.73*
		D	4153	7300	10840	6828	2354	31475	3.19**

* weighted conversion factor
** unweighted conversion factor

Table 15. Calculation of partial recruitment pattern from acoustic purse seine population numbers at age and commercial catch at age.

	Age	Commercial catch ($x10^3$)	Population numbers ($x10^6$)	C/N	Partial recruitment calculated
White Bay-Notre Dame Bay	2	3	630.2	.0000048	.000039
	3	187	640.3	.0002921	.002402
	4	350	5.8	.0603448	.499793
	5	240	-	-	-
	6	1485	12.3	.1207317	1.000000
	7	108	-	-	-
	8	275	-	-	-
	9	94	-	-	-
	10	80	-	-	-
	11+	2106	24.6	.0856098	.709103
Bonavista Bay-Trinity Bay	2	10	134.8	.0000742	.00114
	3	158	268.0	.0005896	.00903
	4	63	3.6	.0175000	.26802
	5	84	-	-	-
	6	333	5.1	.0652941	1.00000
	7	36	-	-	-
	8	26	-	-	-
	9	13	-	-	-
	10	22	-	-	-
	11+	767	1.5	.5113000	-

Table 16. Calculation of instantaneous total mortality (Z) from research gillnet program, where F is number of days fished.

AREA	COMMUNITY	Z4+ 80-81	81-82	82-83	83-84	84-85	83-85
WB/ NDB	CROQUE	-	-	-	-	0.60	-
	WESTPORT	0.39	0.18	0.84	0.21	-0.81	-0.75
	BRENTS COVE	-	-	-0.67	-0.01	2.12	1.77
	LA SCIE	1.35	-	-	-	-	-
	HARRY'S HARBOUR	-	-	-	2.14	0.04	0.15
	LEADING TICKLES	-	-	-	-0.02	-0.64	-0.63
	HILLGRADE	2.09	-	-	-	-	-
	HERRING NECK	-	-	-	-	0.74	-
	COMBINED	2.00	-0.62	-0.53	2.53	0.56	0.83
BB/ TB	CENTREVILLE	-0.22	0.72	-0.04	-0.02	0.79	0.90
	SALVAGE	3.22	-3.47	0.99	0.71	3.51	4.29
	PORTLAND	-	2.06	-	-	-	-
	CHARLOTTETOWN	-	-	-	0.83	0.45	1.27
	NEWMAN SD. (S)	-	-	-	0.18	0.14	0.31
	NEWMAN SD. (F)	-	-	-	-	-2.05	-
	PORT REXTON	-	-	-1.32	1.56	0.78	2.28
	HICKMANS HR.	-	-	-	-	-	-
	LONG BEACH	-	-	-	-1.97	3.61	1.88
	CHANCE CV. (S)	-	-	-	-	-	-
	COMBINED (F)	0.62	-0.27	-0.19	0.74	1.41	2.15
	COMBINED (S)	-	-	-	0.18	1.23	1.44
CB/ SS	BAY ROBERTS (F)	-	-	-	-3.14	0.71	-2.47
	FOXTRAP (S)	-	-	-	-	-	-
	BURNT COVE (F)	-	-	-	-	-	-
	BURNT COVE (S)	-	-	-	-	-	-
	COMBINED (F)	-	-	-	-	2.19	-0.65

Table 17. Calculation of instantaneous total mortality (Z) from research gillnet program, where F is number of days hauled.

AREA	COMMUNITY	Z4+ 80-81	81-82	82-83	83-84	84-85	83-85
WB/ NDB	CROQUE	-	-	-	-	0.55	-
	WESTPORT	1.26	-0.42	0.89	0.21	-0.68	-0.62
	BRENTS COVE	-	-	-0.41	-0.22	2.13	1.98
	LA SCIE	1.14	-	-	-	-	-
	HARRY'S HARBOUR	-	-	-	2.10	-0.02	0.05
	LEADING TICKLES	-	-	-	-0.02	-0.73	-0.72
	HILLGRADE	1.93	-	-	-	-	-
	HERRING NECK	-	-	-	-	0.59	-
	COMBINED	1.92	-0.53	-0.37	0.18	0.48	0.70
BB/ TB	CENTREVILLE	-0.04	0.67	0.10	-0.10	0.80	0.83
	SALVAGE	3.22	-3.55	1.09	0.55	3.54	4.17
	PORTLAND	-	1.12	-	-	-	-
	CHARLOTTETOWN	-	-	-	0.53	0.57	1.09
	NEWMAN SD. (S)	-	-	-	0.27	0.27	0.54
	NEWMAN SD. (F)	-	-	-	-	-1.85	-
	PORT REXTON	-	-	-1.43	1.72	0.66	2.32
	HICKMANS HR.	-	-	-	-	-	-
	LONG BEACH	-	-	-	-1.90	3.46	1.80
	CHANCE CV. (S)	-	-	-	-	-	-
	COMBINED (F)	0.74	-0.42	-0.08	0.71	1.39	2.10
	COMBINED (S)	-	-	-	0.27	0.90	1.20
CB/ SS	BAY ROBERTS (F)	-	-	-	-2.51	0.50	-2.04
	FOXTRAP (S)	-	-	-	-	-	-
	BURNT COVE (F)	-	-	-	-	-	-
	BURNT COVE (S)	-	-	-	-	-	-
	COMBINED (F)	-	-	-	-	2.10	-0.11

Table 18. Calculation of herring biomass from acoustic purse seine surveys, 1983-85, for White Bay (WB), Notre Dame Bay (NDB), Bonavista Bay (BB), Trinity Bay (TB), and Conception Bay (CB).

AREA	YEAR	TONS OBSERVED	KM SURVEYED	KM^2 SURVEYED	TONS/KM^2	KM^2 (<90M)	BIOMASS t (<90M)
WB	1985	1073	207.4	63.0	17.0	3265.3	55613
NDB	1983	3548	1114.0	338.7	10.5	6146.4	64392
	1984	3450	849.1	258.1	13.4	6146.4	82362
	1985	6393	970.4	295.0	21.7	6146.4	133200
BB	1983	1287	726.0	220.7	5.8	2411.2	14064
	1984	3649	1089.1	331.1	11.0	2411.2	26523
	1985	4420	818.1	248.7	17.8	2411.2	42853
TB	1984	4340	923.2	280.7	15.5	1944.8	30144
	1985	2837	620.9	188.8	15.0	1944.8	29225
CB	1985	23	117.6	35.8	0.7	827.3	541

Table 19. Numbers at age within sampled grids from the 1985 acoustic purse seine survey converted to stock numbers for White Bay - Notre Dame Bay using the ratio of observed biomass to predicted stock biomass.

GRID	OBSERVED BIOMASS	FROM SAMPLES SS	FROM SAMPLES AS	OBS. BIOMASS SS	OBS. BIOMASS AS	MEAN SAMPLE WGT (kg)	OBS NOS ($x10^6$) SS	OBS NOS ($x10^6$) AS
43	249.1	-	-	-	-	-	-	-
45	823.9	-	-	-	-	-	-	-
W.B.	1073.0							
1	2238.1	100.0%	0.0%	2238.1	0.0	0.157	14.26	0.00
2	1105.7	-	-	-	-	-	-	-
3	579.1	-	-	-	-	-	-	-
4	591.7	100.0%	0.0%	591.7	0.0	0.126	4.70	0.00
5	1795.1	97.7%	2.3%	1753.8	41.3	0.133	13.19	0.31
6	83.3	-	-	-	-	-	-	-
N.D.B.	6393.0							

SPRING SPAWNERS ONLY

GRID	PARAMETER	AGE 2	AGE 3	AGE 4	AGE 6	AGE 11+	TOTAL
1	NO. SAMPLED	19	77	1	1	2	100
	%	19.0	77.0	1.0	1.0	2.0	100.0
	OBS. NUMBERS	2.71	10.98	0.14	0.14	0.29	14.26
4	NO. SAMPLED	38	12	-	-	-	50
	%	76.0	24.0	-	-	-	100.0
	OBS. NUMBERS	3.57	1.13	-	-	-	4.70
5	NO. SAMPLED	59	23	-	1	2	85
	%	69.4	27.1	-	1.2	2.4	100.0
	OBS. NUMBERS	9.15	3.57	-	0.16	0.32	13.19
1,4&5	OBS. NUMBERS	15.43	15.68	0.14	0.30	0.60	32.15
43-6	PRE. NUMBERS	24.92	25.32	0.23	0.49	0.97	51.93
	STOCK NUMBERS	630.21	640.35	5.82	12.29	24.57	1313.24
	%	48.0	48.8	0.4	0.9	1.9	100.0

Table 20. Numbers at age within sampled grids from the 1985 acoustic purse seine survey converted to stock numbers for Bonavista Bay - Trinity Bay using the ratio of observed biomass to predicted stock biomass (* For Bonavista Bay, numbers at age for grids 8 and 12 were converted to numbers at age for grids 8, 9, 10, 12 and 13. Numbers at age for grid 11 were then added to derive B.B. numbers. B.B. and T.B. numbers were then combined for final stock estimate.)

GRID	OBSERVED BIOMASS	FROM SAMPLES SS	FROM SAMPLES AS	OBS. BIOMASS SS	OBS. BIOMASS AS	MEAN SAMPLE WGT (kg)	OBS NOS ($\times 10^6$) SS	OBS NOS ($\times 10^6$) AS
8	683.1	100.0%	0.0%	683.1	0.0	0.155	4.41	0.00
9	650.4	-	-	-	-	-	-	-
10	519.9	-	-	-	-	-	-	-
11	14.6	100.0%	0.0%	14.6	0.0	0.003	4.86	0.00
12	1312.9	96.0%	4.0%	1260.4	52.5	0.161	7.83	0.33
13	1239.1	-	-	-	-	-	-	-
B.B.	4420.0							
14	738.5	-	-	-	-	-	-	-
15	720.9	-	-	-	-	-	-	-
16	1063.9	100.0%	0.0%	1063.9	0.0	0.197	5.40	0.00
17	149.5	-	-	-	-	-	-	-
18	145.2	-	-	-	-	-	-	-
19	19.1	-	-	-	-	-	-	-
T.B.	2837.1							

SPRING SPAWNERS ONLY

GRID	PARAMETER	AGE 0	2	3	4	6	11+	TOTAL
8	NO. SAMPLED	-	79	67	1	3	-	150
	%	-	52.6	44.7	0.7	2.0	-	100.0
	OBS. NUMBERS	-	2.32	1.97	0.03	0.09	-	4.41
12	NO. SAMPLED	-	48	47	-	1	-	96
	%	-	50.0	49.0	-	1.0	-	100.0
	OBS. NUMBERS	-	3.91	3.84	-	0.08	-	7.83
8&12	OBS. NUMBERS	-	6.23	5.81	0.03	0.17	-	12.24
*	PRE. NUMBERS	-	13.90	12.95	0.07	0.37	-	27.29
11	NO. SAMPLED	100	-	-	-	-	-	100
	%	100.0	-	-	-	-	-	100.0
	OBS. NUMBERS	4.86	-	-	-	-	-	4.86
8-13	PRE. NUMBERS	4.86	13.90	12.95	0.07	0.37	-	32.15
	B.B. NUMBERS	47.14	134.78	125.55	0.67	3.60	-	311.73
16	NO. SAMPLED	-	-	96	2	1	1	100
	%	-	-	96.0	2.0	1.0	1.0	100.0
	OBS. NUMBERS	-	-	5.18	0.11	0.05	0.05	5.40
4-19	PRE. NUMBERS	-	-	13.83	0.29	0.14	0.14	14.40
	T.B. NUMBERS	-	-	142.41	2.97	1.48	1.48	148.35
	STOCK NUMBERS	47.14	134.78	267.97	3.63	5.08	1.48	460.08
	%	10.2	29.3	58.2	0.8	1.1	0.3	100.0

Table 21. Stock numbers at age and biomass estimates derived from acoustic purse seine surveys, 1983-85, for White Bay - Notre Dame Bay (WD-NDB) and Bonavista Bay - Trinity Bay (BB-TB).

		NUMBERS AT AGE ($x10^6$)		
AREA	AGE	1983	1984	1985
WB-NDB	0	673.1	-	-
	1	575.5	366.2	-
	2	34.6	648.1	630.2
	3	2.5	5.4	640.3
	4	66.3	5.2	5.8
	5	3.8	13.7	-
	6	5.7	4.7	12.3
	7	17.0	2.5	-
	8	-	5.9	-
	9	7.6	-	-
	10	-	1.3	-
	11+	47.3	64.6	24.6
TOTAL NUMBERS		1433.5	1117.7	1313.2
BIOMASS (t)		91437	116750	188814
BB-TB	0	0.8	473.3	47.1
	1	649.7	113.9	-
	2	0.8	347.0	134.8
	3	-	1.6	268.0
	4	-	3.8	3.6
	5	-	10.1	-
	6	-	0.4	5.1
	7	-	-	-
	8	-	0.4	-
	9	-	-	-
	10	-	1.6	-
	11+	-	15.2	1.5
TOTAL NUMBERS		651.2	967.3	460.1
BIOMASS (t)		26159	56667	72077

Table 22. 1987 catch projections, using the population numbers for the 1982 and 1983 year-classes from the acoustic purse seine survey, zero recruitment at age 2, and a partial recruitment vector for a combined purse seine and gillnet fishery.

Area	Age	Pop. nos. ($x10^3$)	Pop. wgt. (t)	Fish. mort.	Catch nos. ($x10^3$)	Catch wgt. (t)	Residual nos. ($x10^3$)
White Bay-Notre Dame Bay	4	230453	45399	0.18	34510	6799	157598
	5	399224	104597	0.30	94249	24693	242142
	Total	629677	149996		128759	31492	399740
Bonavista Bay-Trinity Bay	4	70848	14099	0.18	10609	2111	48450
	5	209538	49032	0.30	49468	11576	127091
	Total	280386	63131		60077	13687	175541

Table 23. Illustrative projections, 1986-92, for White Bay-Notre Dame Bay using the 1982 and 1983 year-class population numbers, zero recruitment at age 2, a combined purse seine and gillnet partial recruitment vector, and options of F = 0.30, F = 0.20, C = 5000 t, and C = 10000 t.

Option	Year	5+ population nos. ($x10^3$)	5+ population weight (t)	F_{5+}	Catch nos. ($x10^3$)	Catch wgt. (t)
F = 0.30	1986	0	0	0.00	30940	5500
	1987	399224	104597	0.30	128760	31492
	1988	399741	104974	0.30	94371	24782
	1989	242455	69200	0.30	57239	16337
	1990	147057	46344	0.30	34717	10941
	1991	89194	29366	0.30	21057	6933
	1992	54099	18649	0.30	12772	4403
F = 0.20	1986	0	0	0.00	30940	5500
	1987	399224	104597	0.20	89497	21904
	1988	434952	114225	0.20	71697	18829
	1989	291557	83317	0.20	48060	13734
	1990	195437	61637	0.20	32216	10160
	1991	131005	43141	0.20	21595	7111
	1992	87816	30289	0.20	14475	4993
C = 5000 t	1986	0	0	0.00	30940	5500
	1987	399224	104597	0.04	20393	5000
	1988	497127	130561	0.04	19038	5000
	1989	389828	111612	0.05	17463	5000
	1990	303402	95800	0.06	15835	5000
	1991	234114	77120	0.07	15179	5000
	1992	177982	61445	0.09	14483	5000
C = 10,000 t	1986	0	0	0.00	30940	5500
	1987	399224	104597	0.09	40804	10000
	1988	478725	125726	0.09	38077	10000
	1989	357603	102331	0.11	34946	10000
	1990	261273	82470	0.14	31681	10000
	1991	185362	61055	0.20	30360	10000
	1992	124427	42945	0.30	28973	10000

Table 24. Illustrative projections, 1986-92, for Bonavista Bay-Trinity Bay using the 1982 and 1983 year-class population numbers, zero recruitment at age 2, a combined purse seine and gillnet partial recruitment vector, and options of F = 0.30, F = 0.20, C = 4000 t, and C = 8000 t.

Option	Year	5+ population nos. ($x10^3$)	5+ population weight (t)	F_{5+}	Catch nos. ($x10^3$)	Catch wgt. (t)
F = 0.30	1986	0	0	0.00	20449	3800
	1987	209538	49032	0.30	60078	13687
	1988	175542	46160	0.30	41442	10898
	1989	106472	31225	0.30	25136	7379
	1990	64578	21402	0.30	15246	5053
	1991	39169	13321	0.30	9247	3145
	1992	23757	8501	0.30	5609	2007
F = 0.20	1986	0	0	0.00	20449	3800
	1987	209538	49032	0.20	41816	9530
	1988	191904	50524	0.20	31633	8328
	1989	128637	37789	0.20	21205	6229
	1990	86228	28605	0.20	14214	4715
	1991	57801	19656	0.20	9528	3240
	1992	38745	13872	0.20	6387	2287
C = 4000 t	1986	0	0	0.00	20449	3800
	1987	209538	49032	0.08	17542	4000
	1988	213734	56351	0.08	15172	4000
	1989	161305	47425	0.10	13605	4000
	1990	119795	39788	0.12	12043	4000
	1991	87222	29659	0.16	11763	4000
	1992	60814	21788	0.23	11165	4000
C = 8000 t	1986	0	0	0.00	20449	3800
	1987	209538	49032	0.17	35097	8000
	1988	197938	52134	0.19	30374	8000
	1989	134705	39581	0.25	27226	8000
	1990	85795	28472	0.37	24107	8000
	1991	48600	16527	0.75	23525	8000
	1992	18800	6500	-	-	-

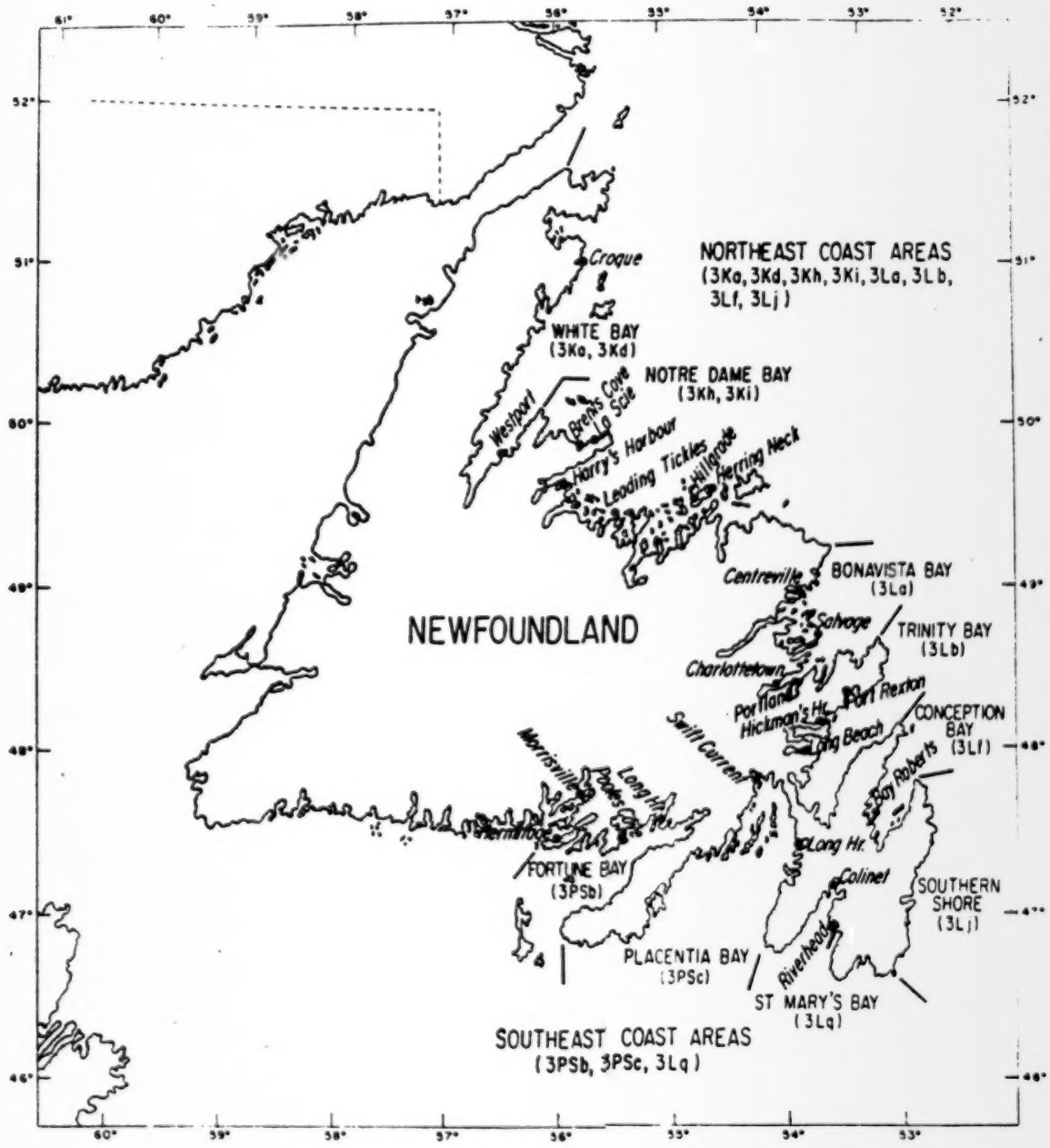


Fig. 1. Area map indicating herring stock complexes and research gillnet community locations.

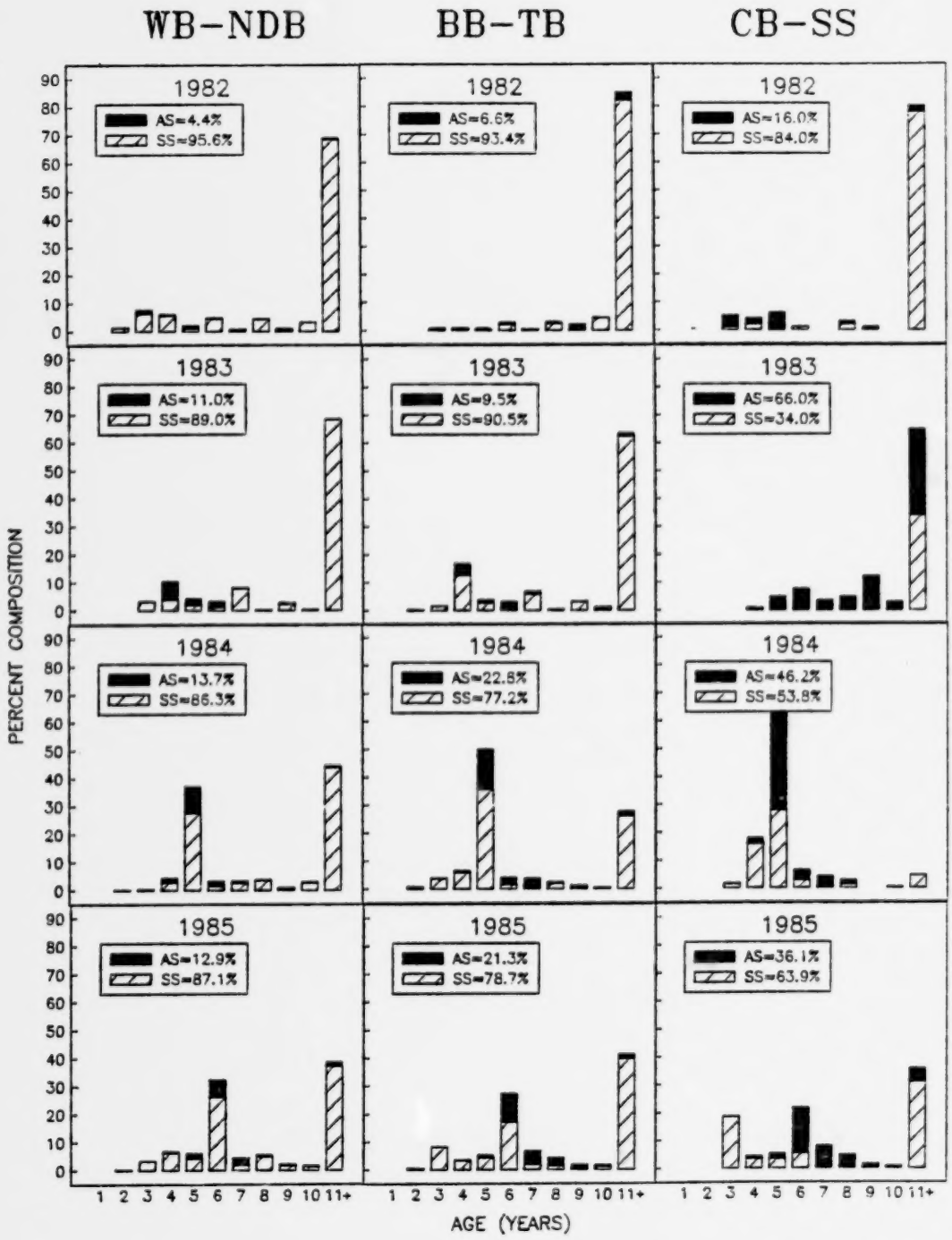


Fig.2. Age composition of herring from the commercial fishery, White Bay – Notre Dame Bay (WB–NDB), Bonavista Bay – Trinity Bay (BB–TB), and Conception Bay – Southern Shore (CB–SS), 1982–85

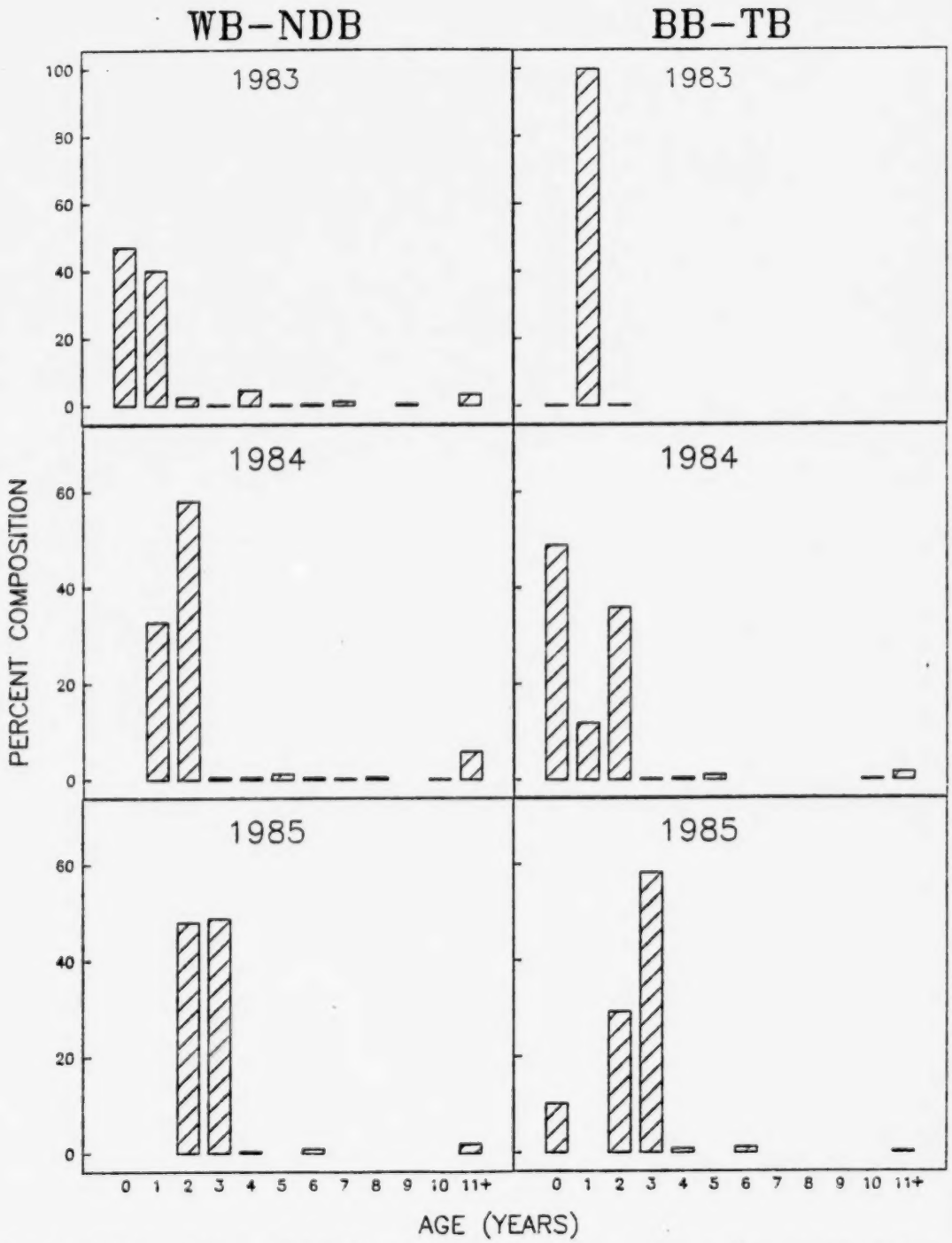


Fig.3. Stock age composition of herring from acoustic purse seine surveys, 1983–85, for White Bay –Notre Dame Bay (WB–NDB), and Bonavista Bay –Trinity Bay (BB–TB).

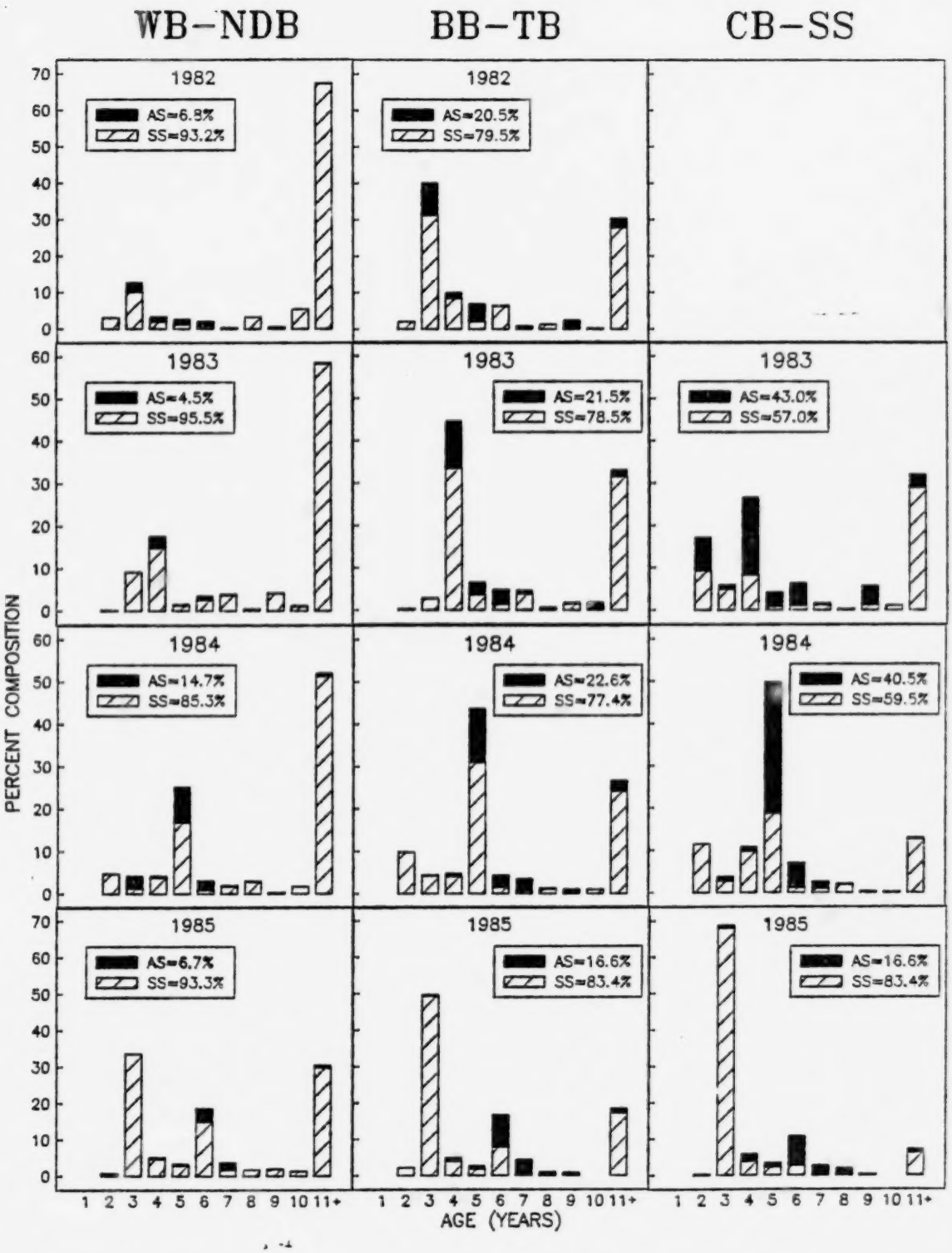


Fig.4. Age composition of herring from research gillnets, White Bay – Notre Dame Bay, Bonavista Bay – Trinity Bay, and Conception Bay – Southern Shore, 1982–85.

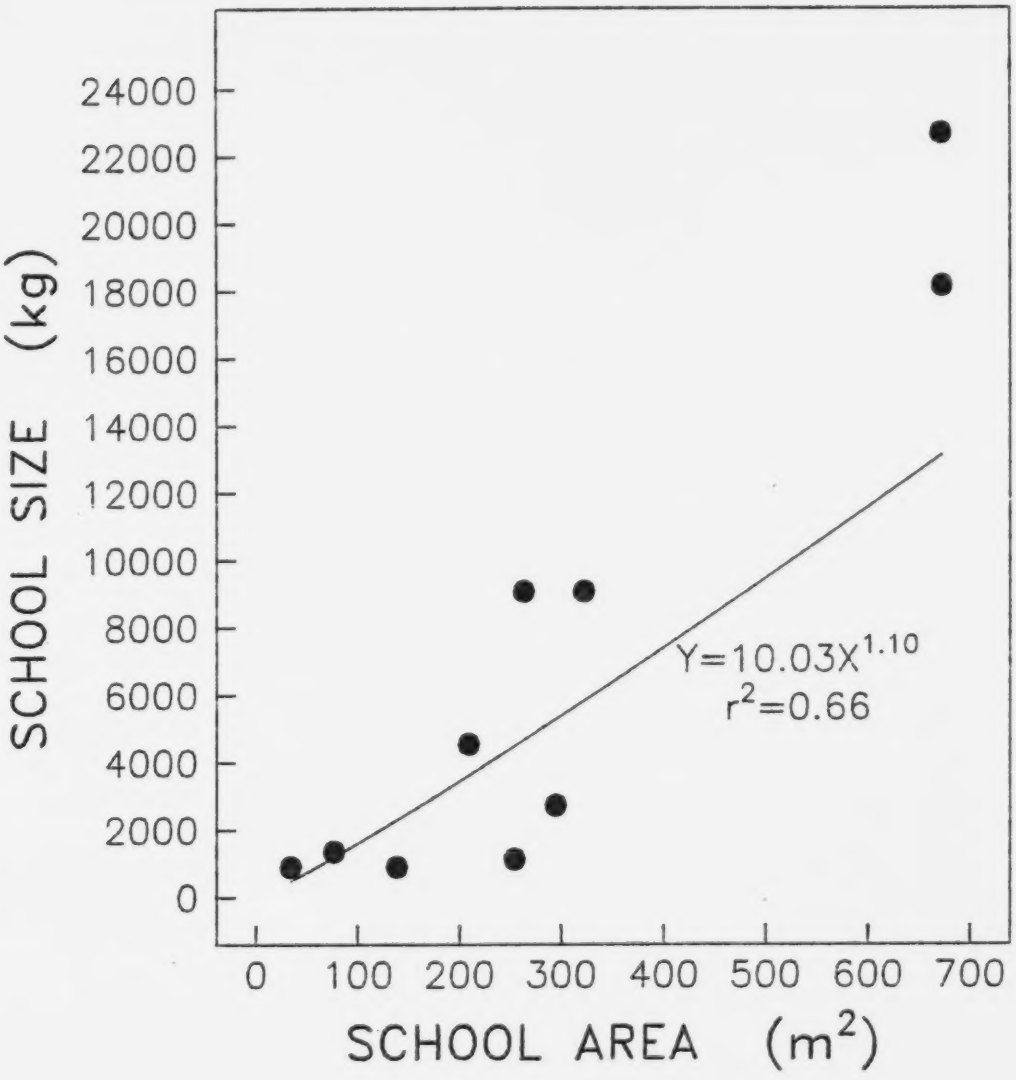


Fig.5. Relation between school area and school size.

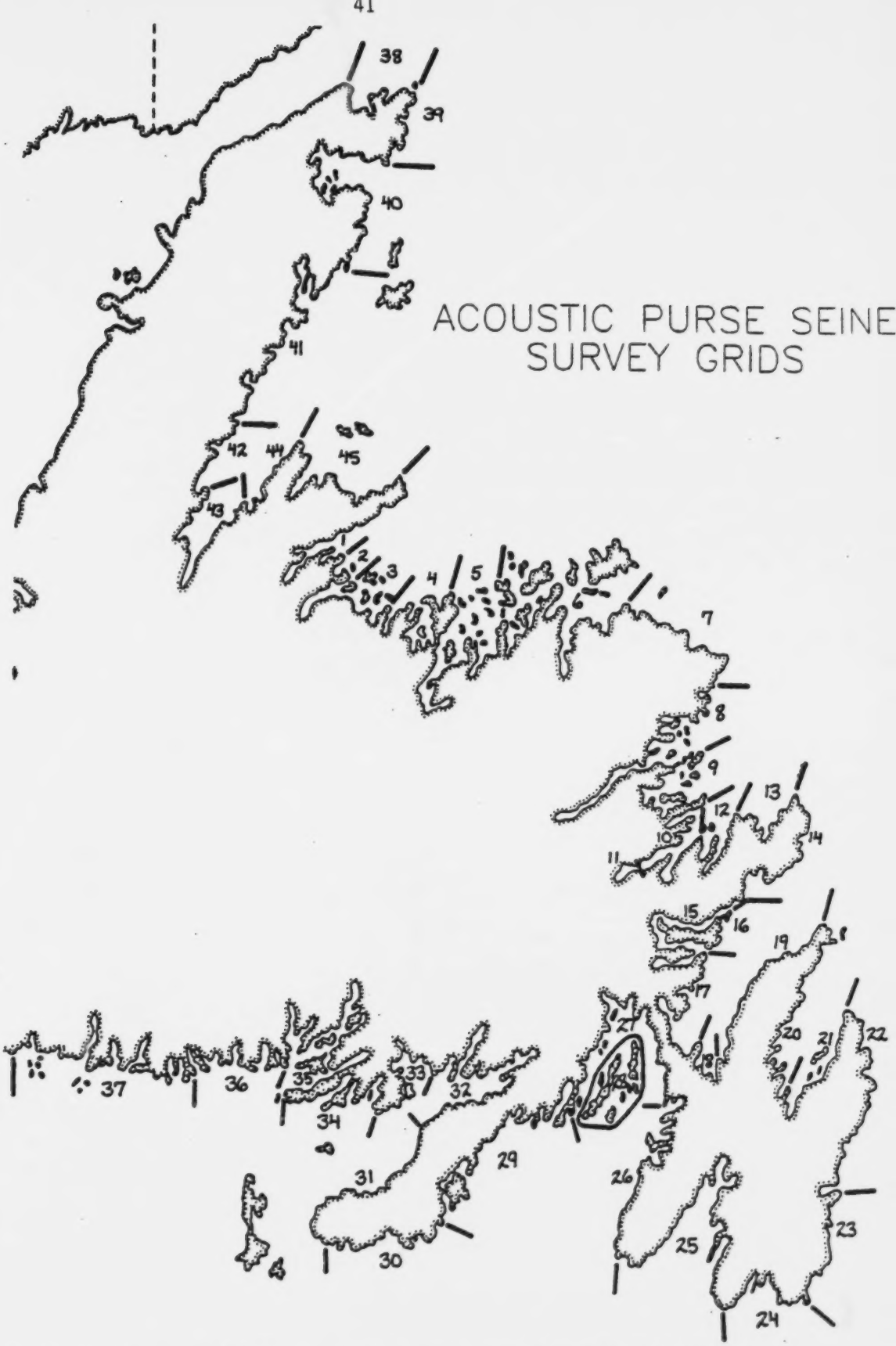
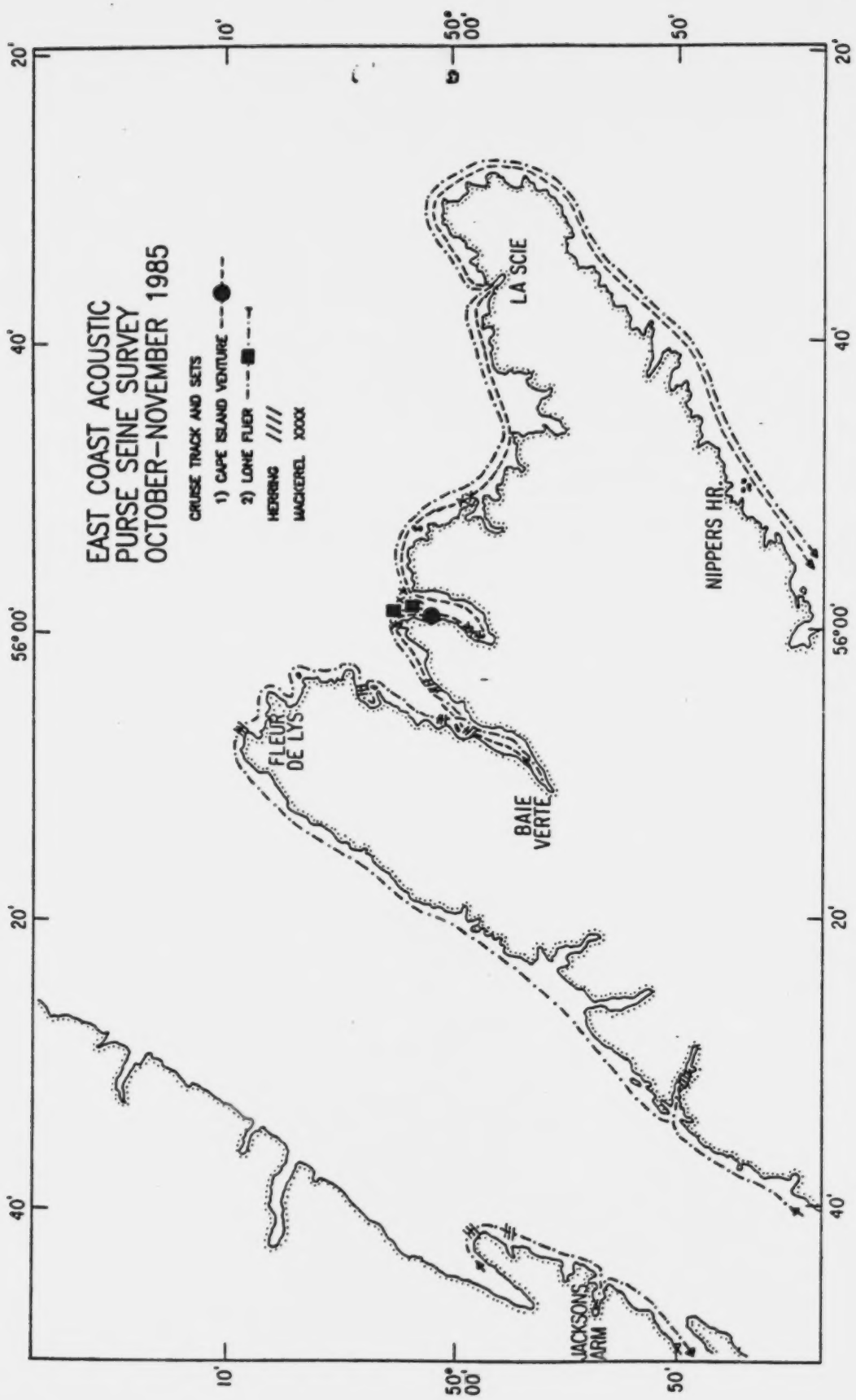
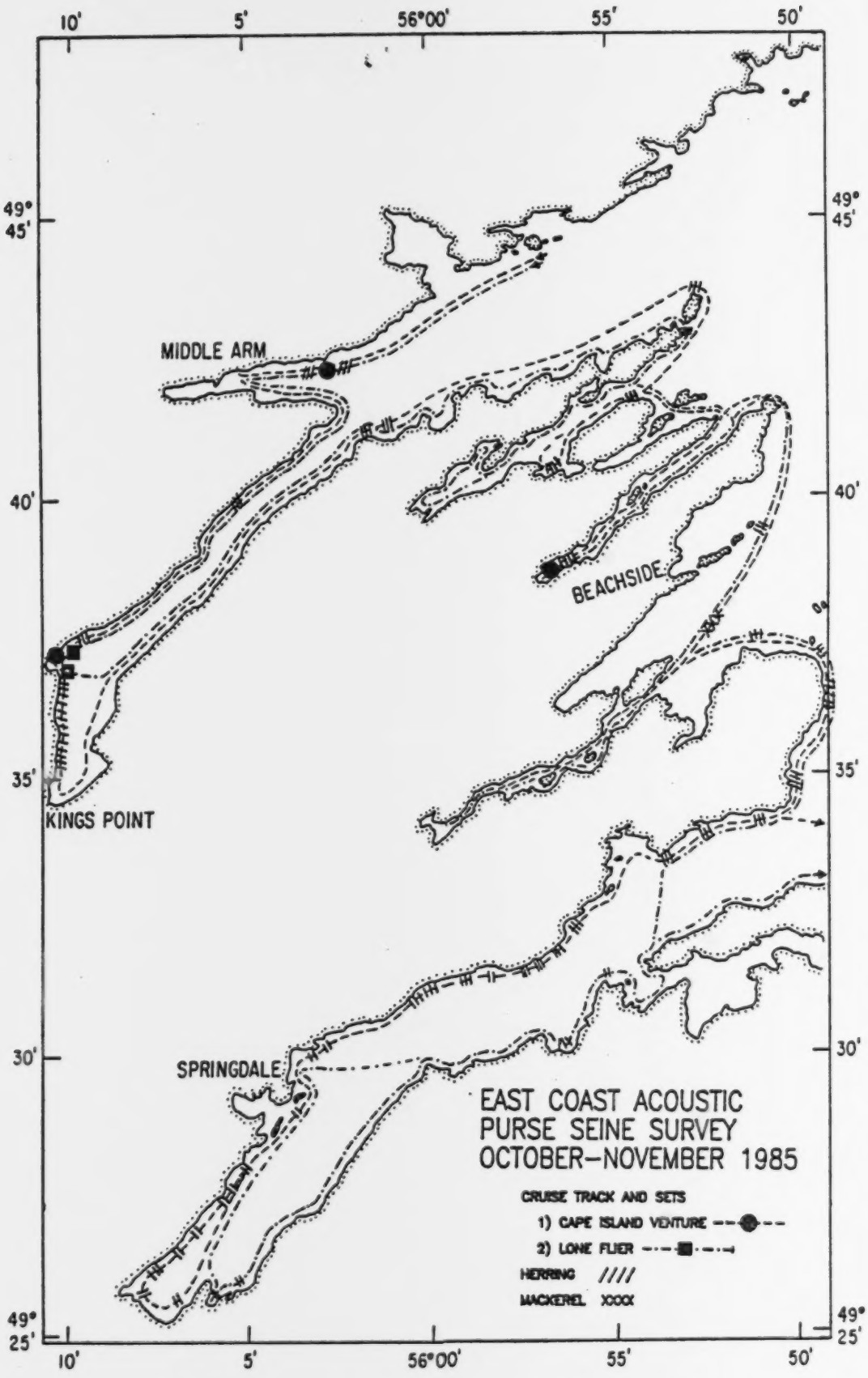


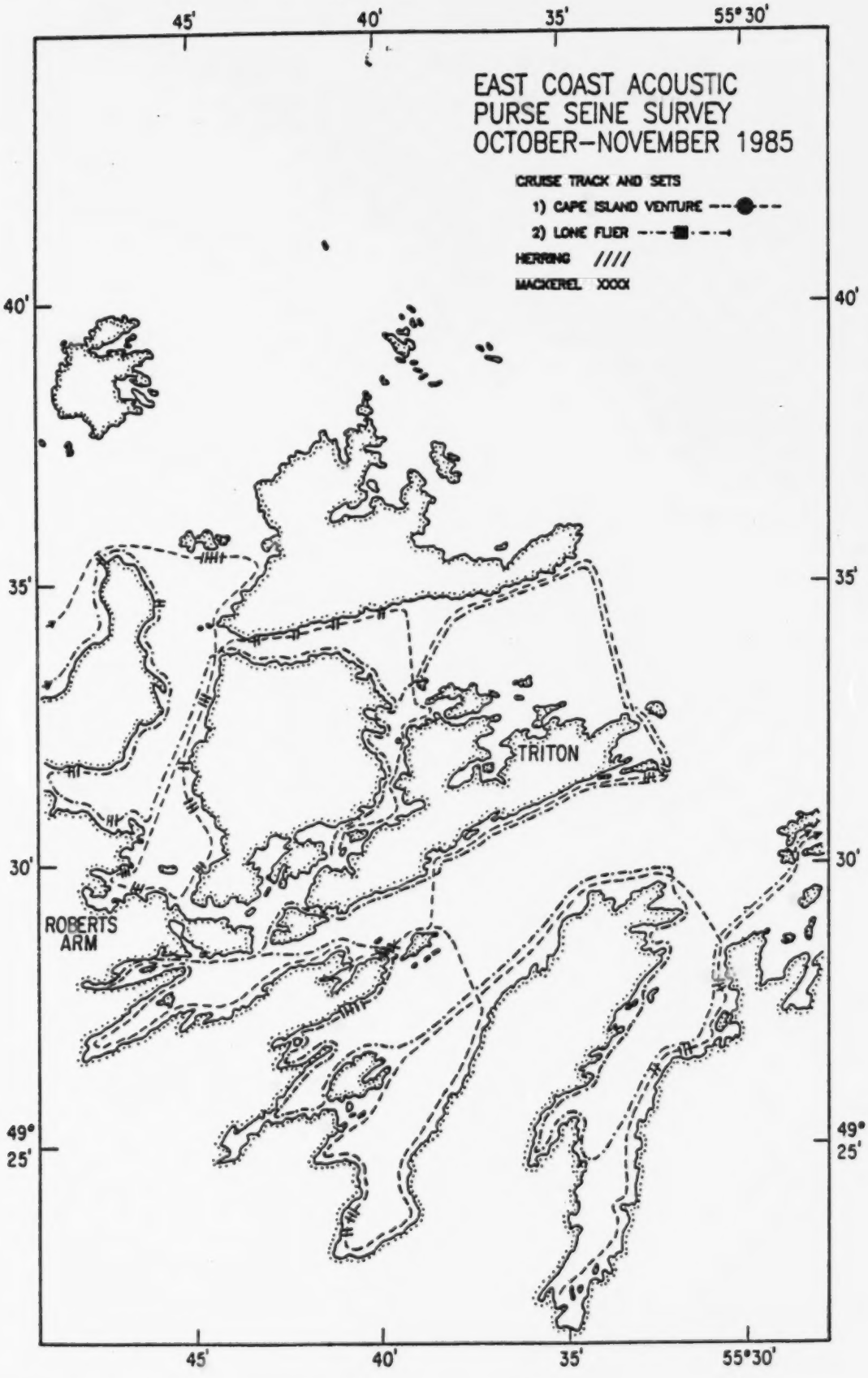
Fig. 6. Grids or subareas within each stock area used for the calculation of stock biomass from the acoustic purse seine survey.



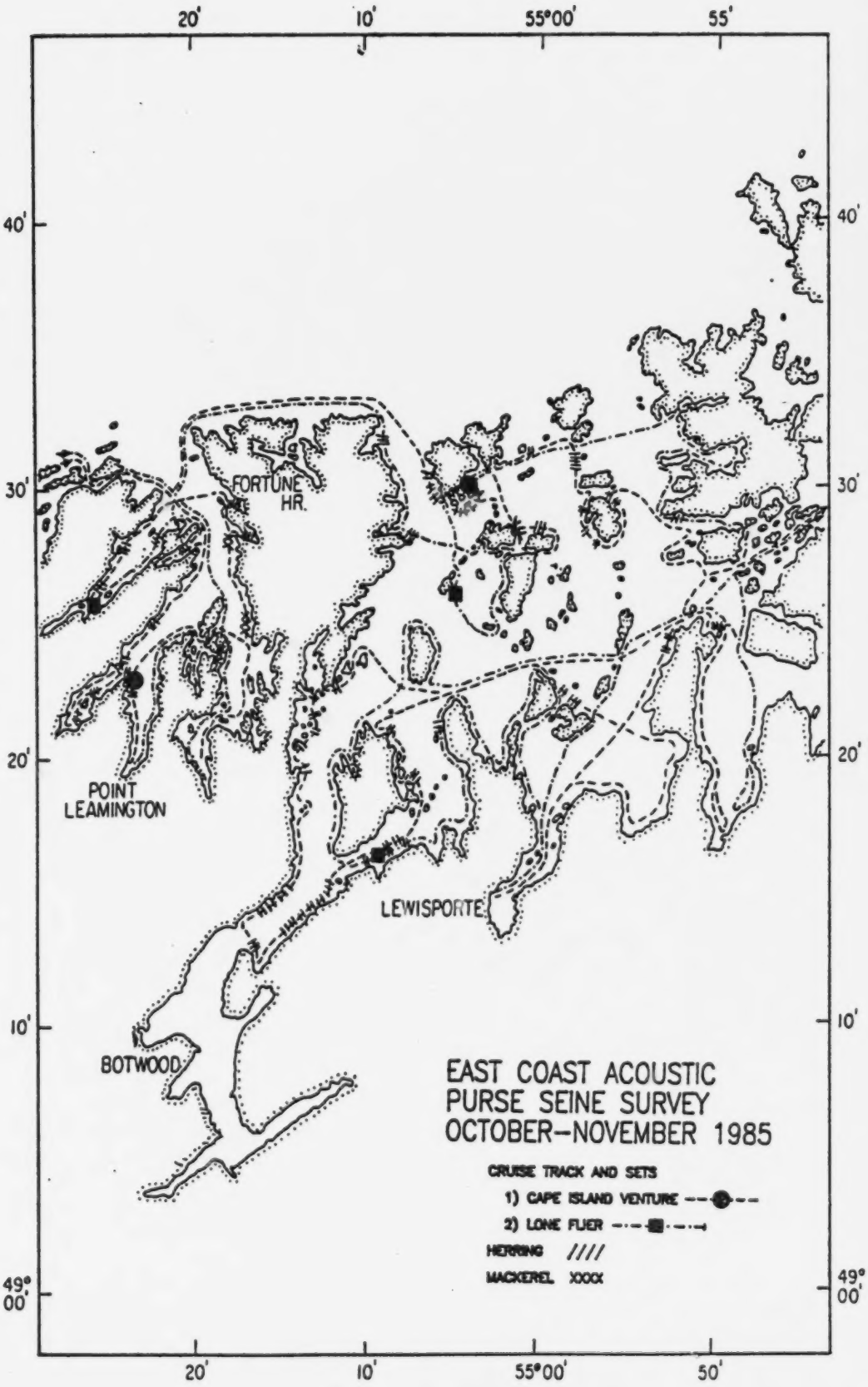
App. 1. Cruise track, herring markings, and set locations, acoustic purse seine survey, White Bay, 1985.



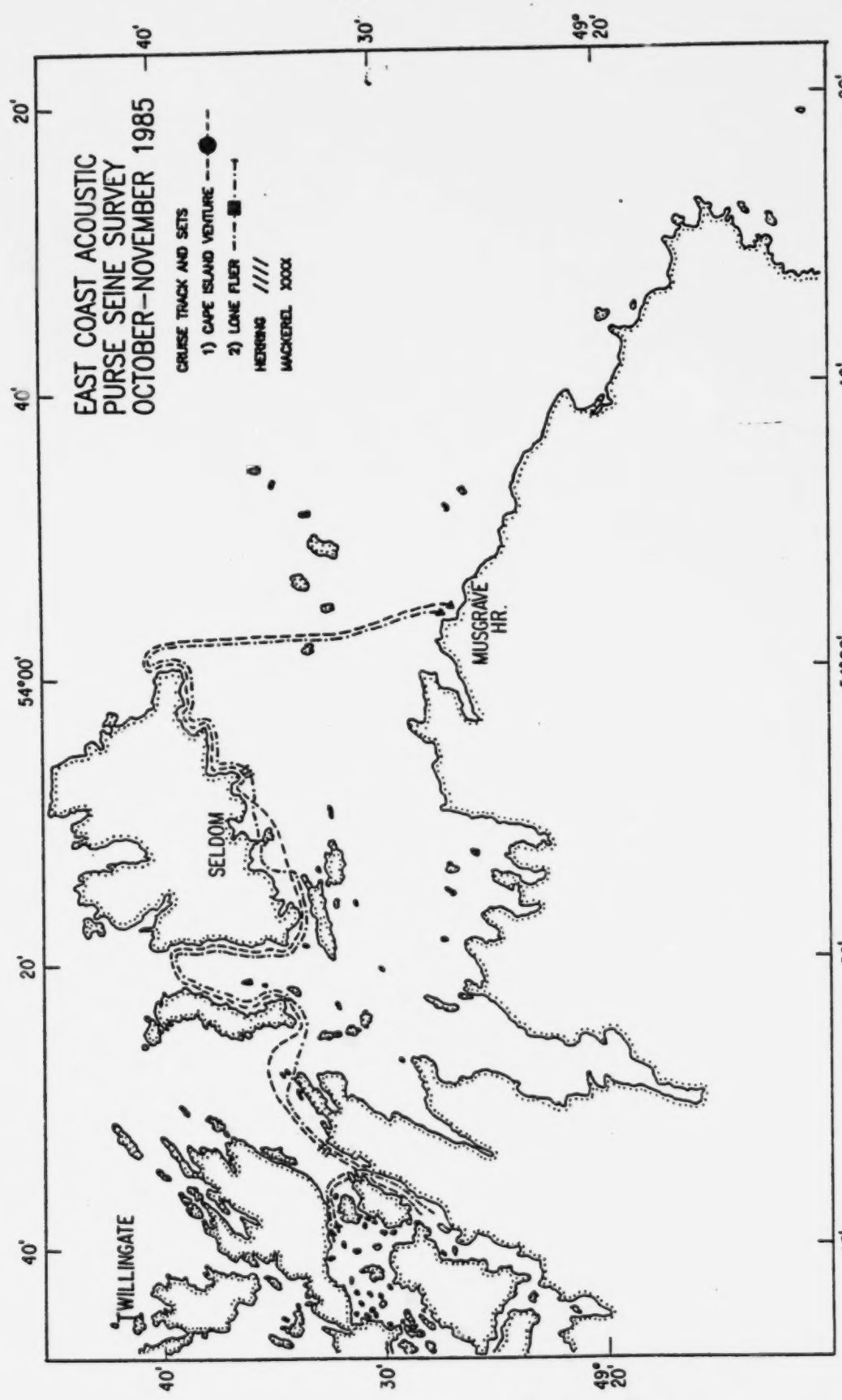
App. 2. Cruise track, herring markings, and set locations, acoustic purse seine survey, Green Bay – Halls Bay, 1985.



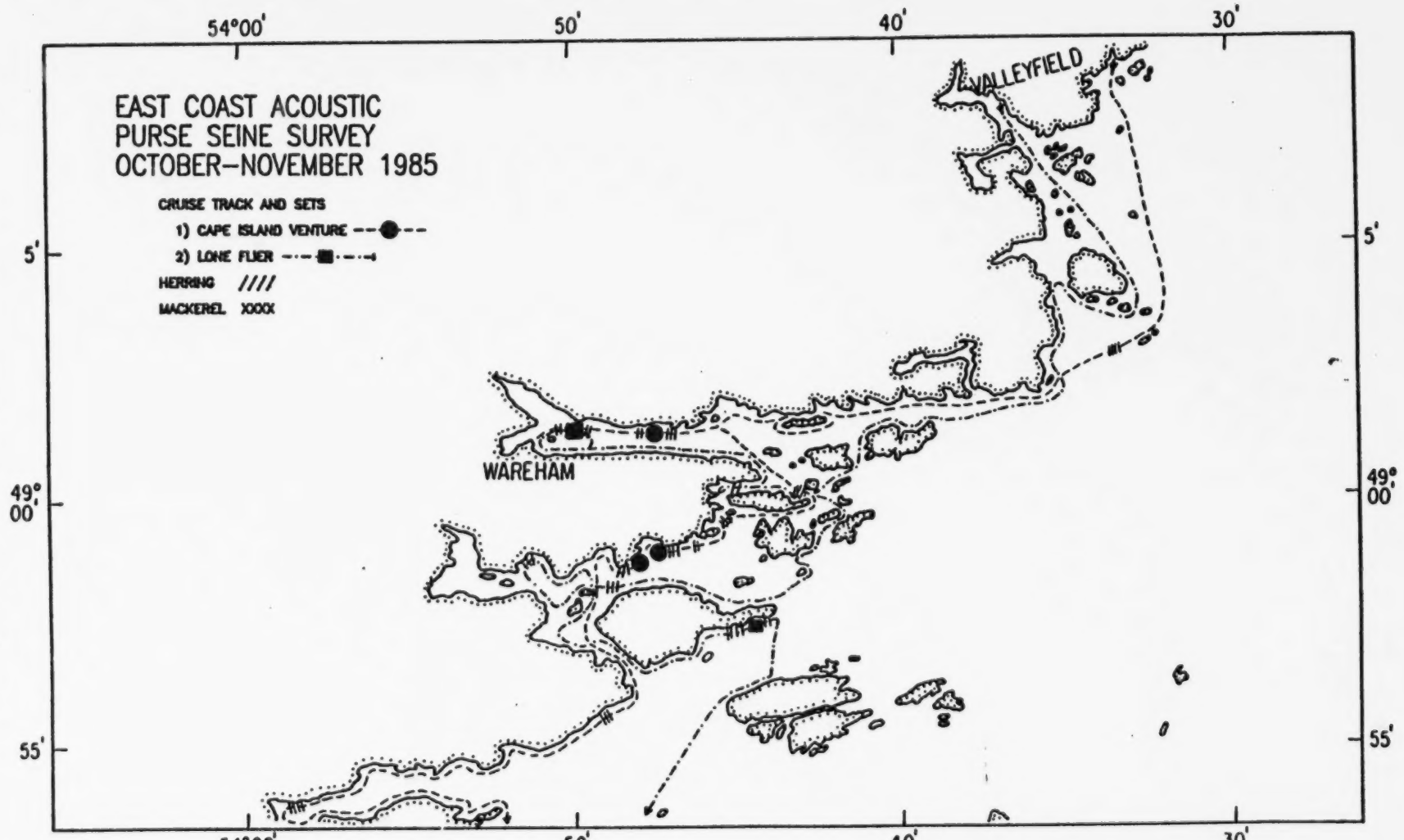
App. 3. Cruise track, herring markings, and set locations, acoustic purse seine survey, Badger Bay – Seal Bay, 1985.



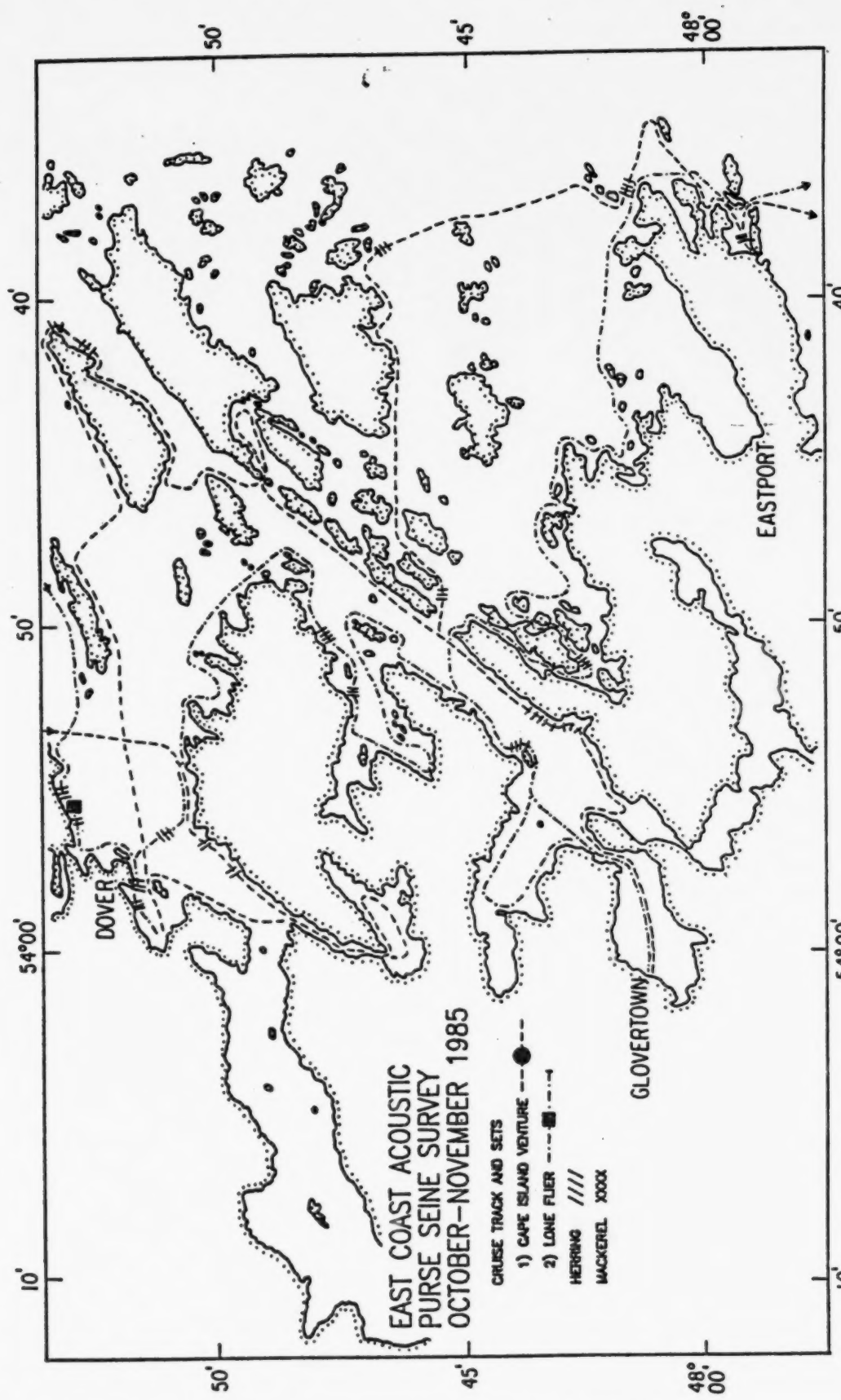
App. 4. Cruise track, herring markings, and set locations, acoustic purse seine survey, New Bay – Bay of Exploits, 1985.



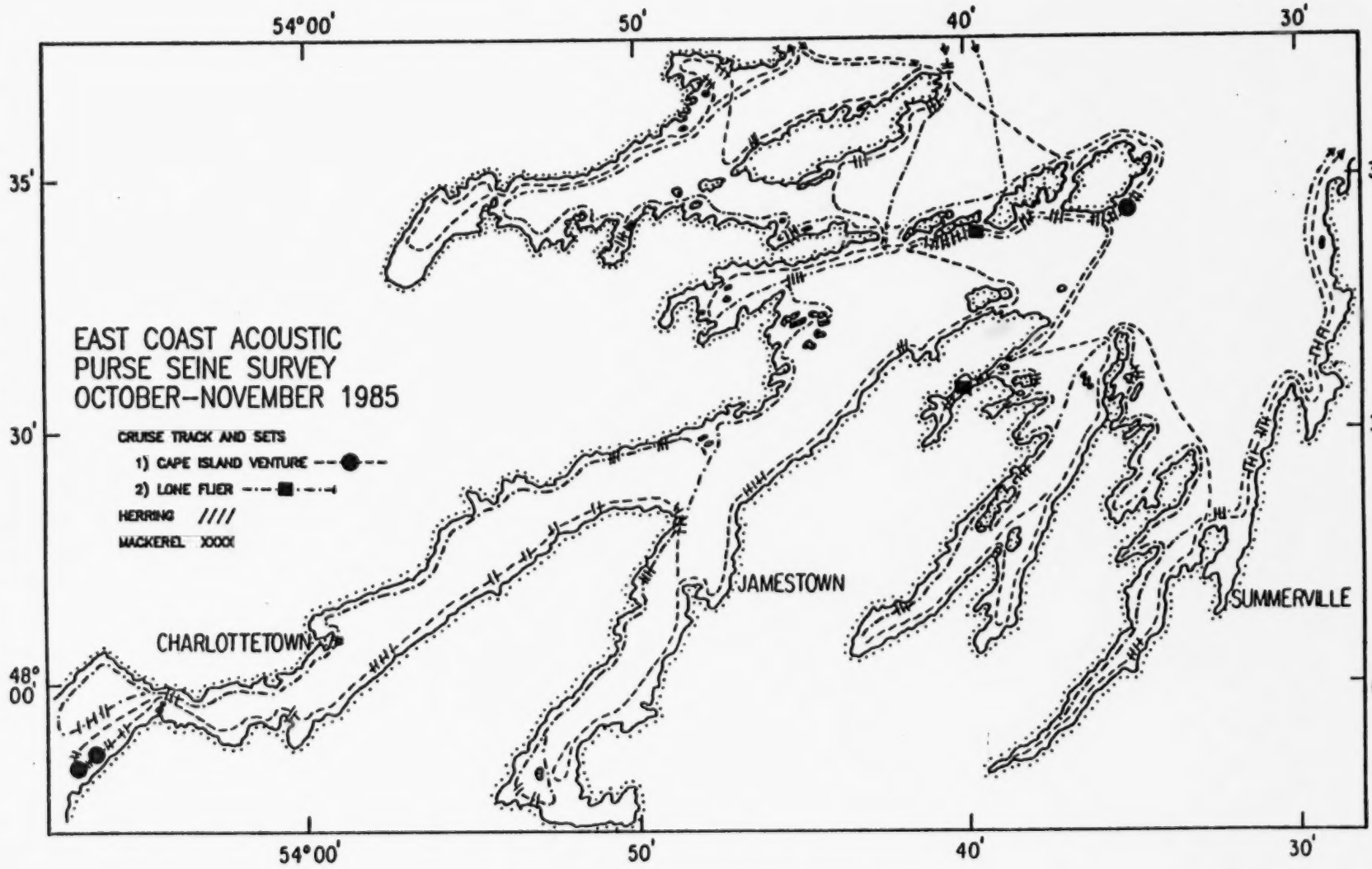
App. 5. Cruise track, herring markings, and set locations, acoustic purse seine survey, Hamilton Sound, 1985.



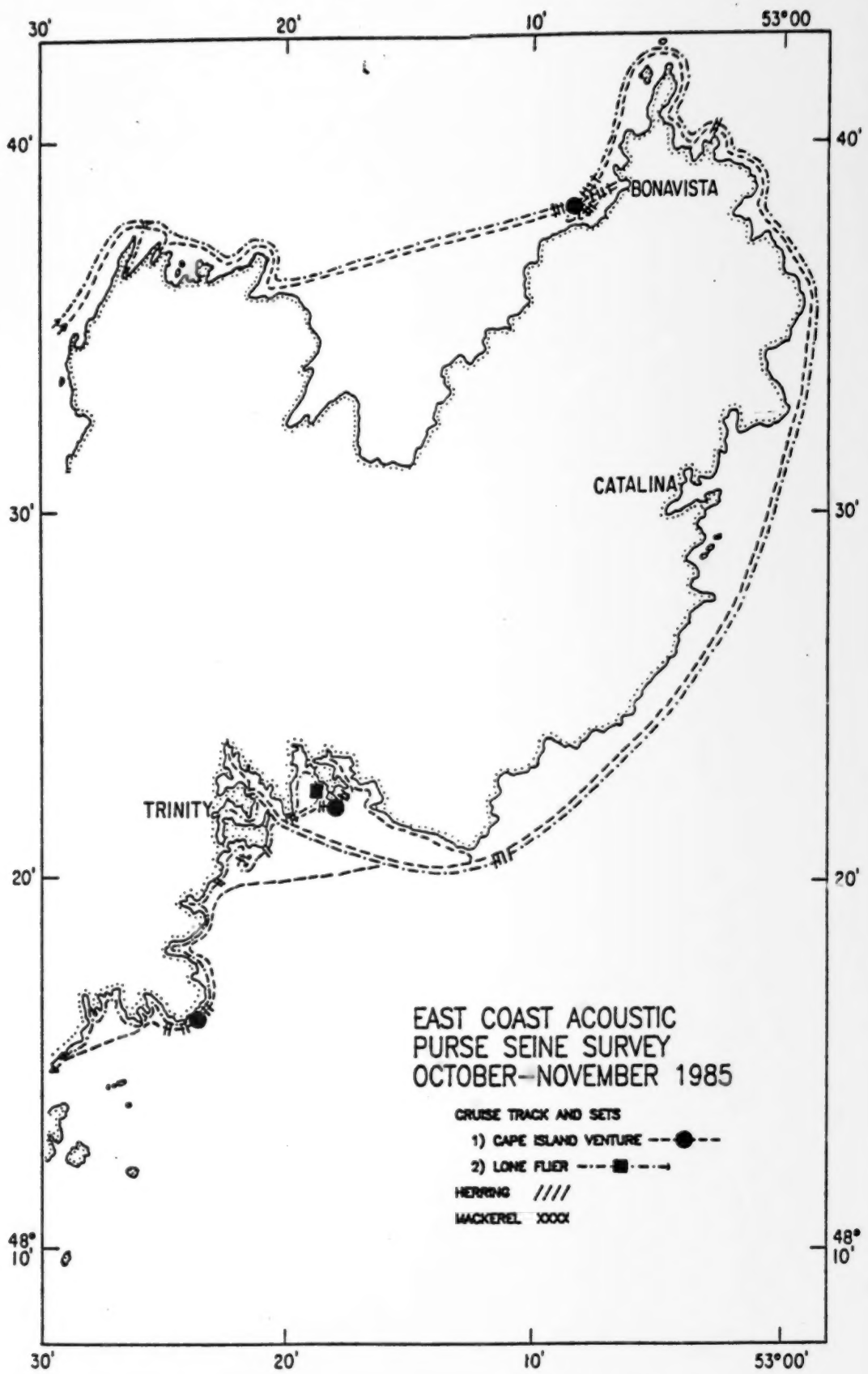
App. 6. Cruise track, herring markings, and set locations, acoustic purse seine survey, Bonavista Bay North, 1985.



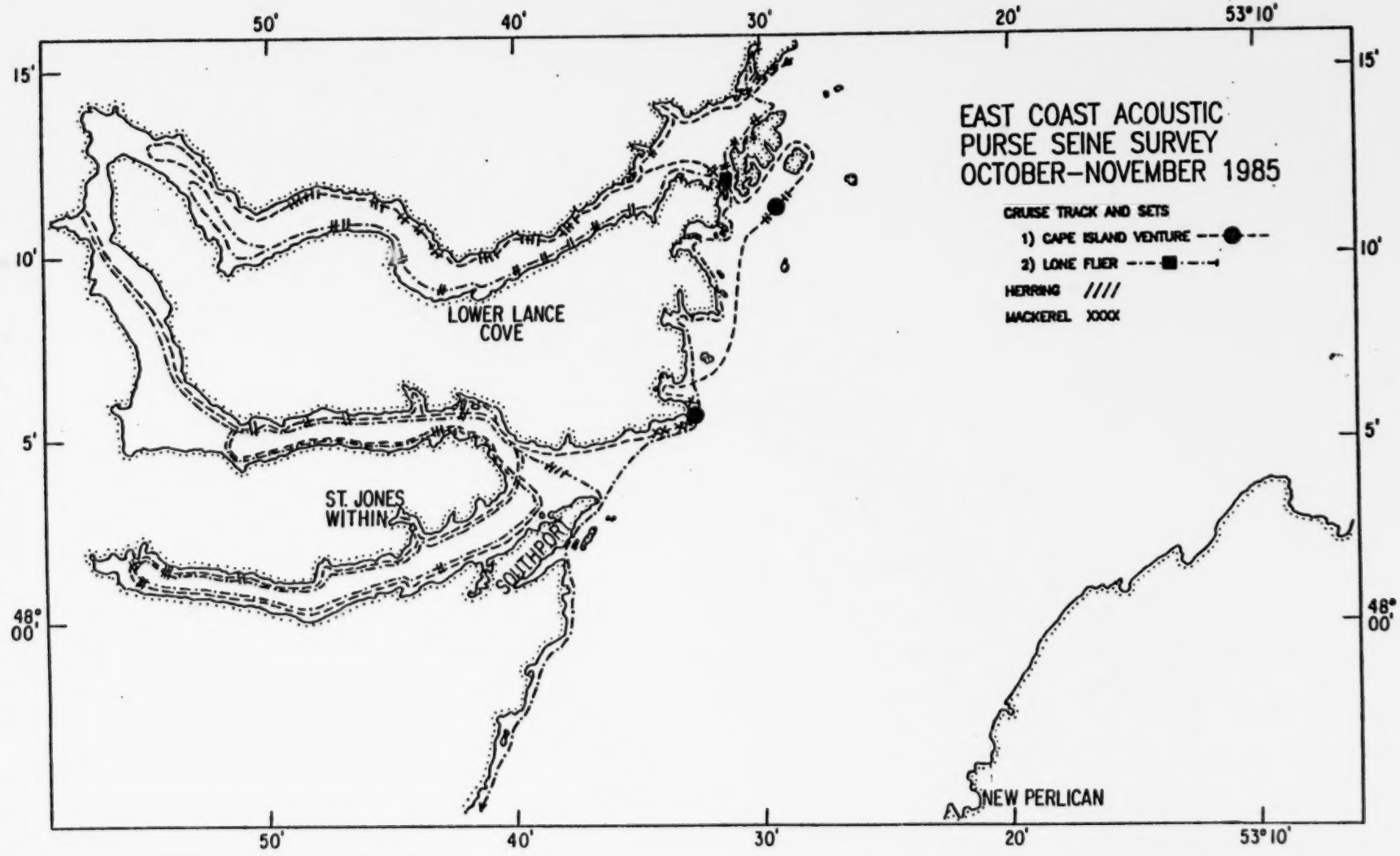
App. 7. Cruise track, herring markings, and set locations, acoustic purse seine survey, Bloody Reach B.B., 1985.



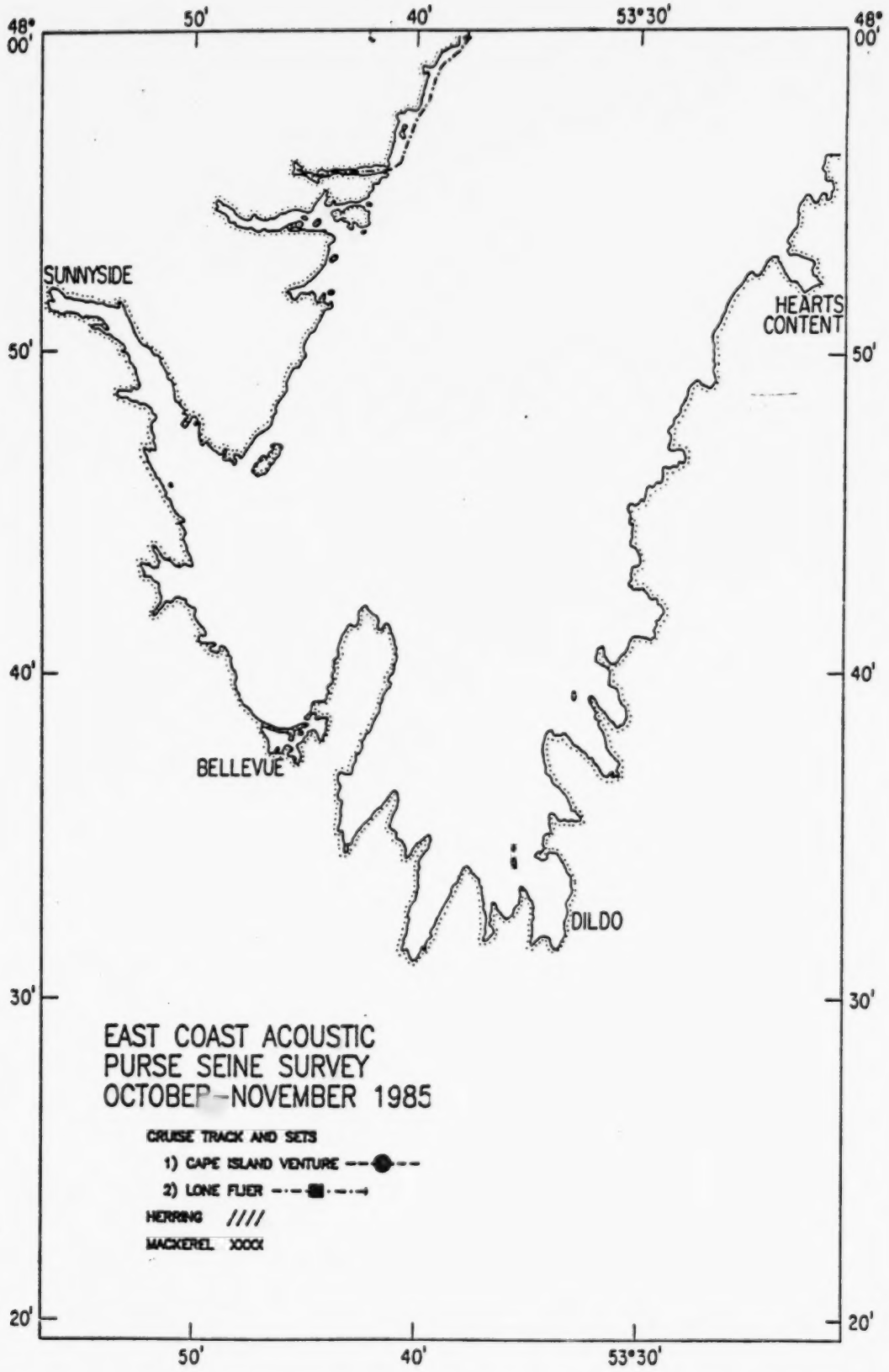
App. 8. Cruise track, herring markings, and set locations, acoustic purse seine survey, Chandlers Reach B.B., 1985.



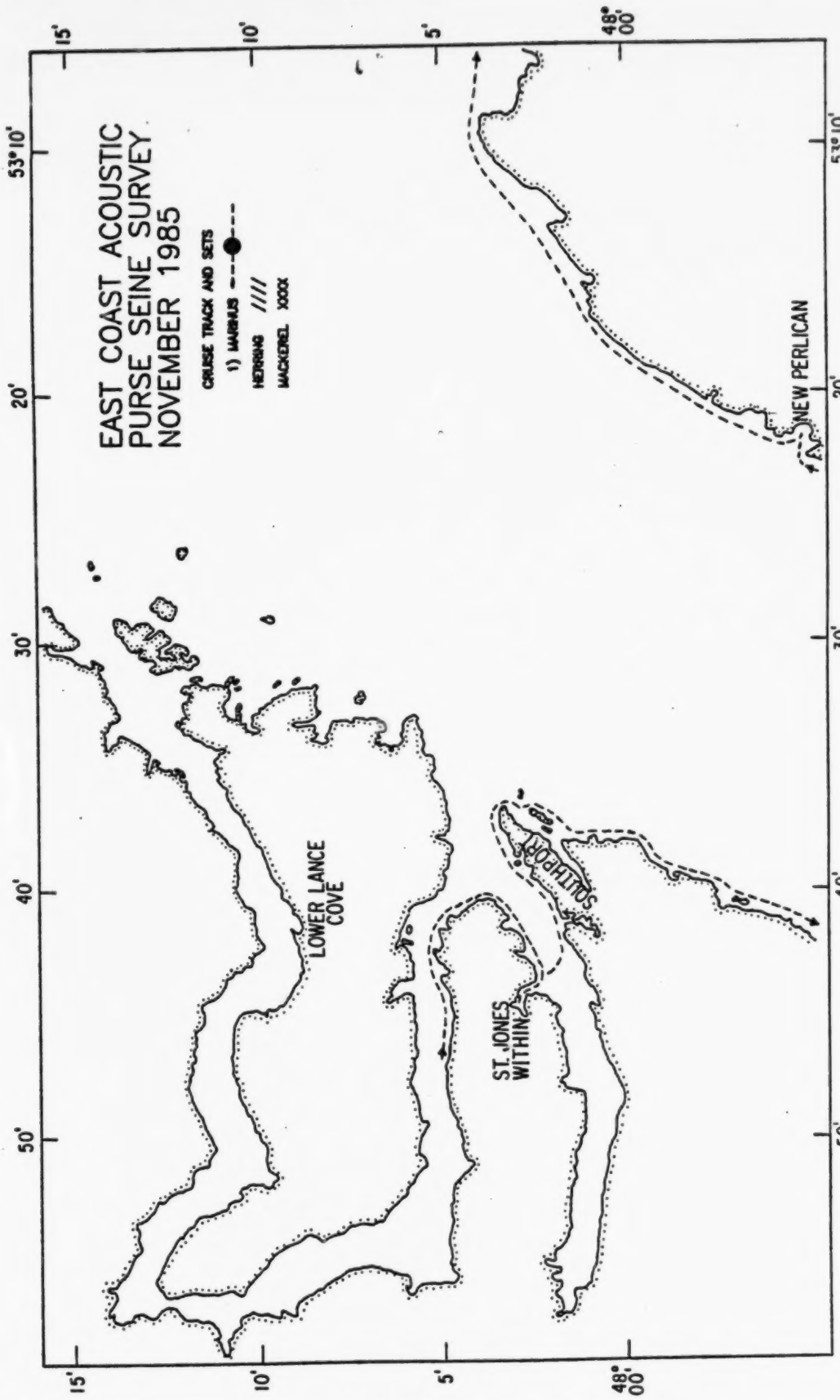
App. 9. Cruise track, herring markings, and set locations, acoustic purse seine survey, Bonavista – Trinity, 1985.



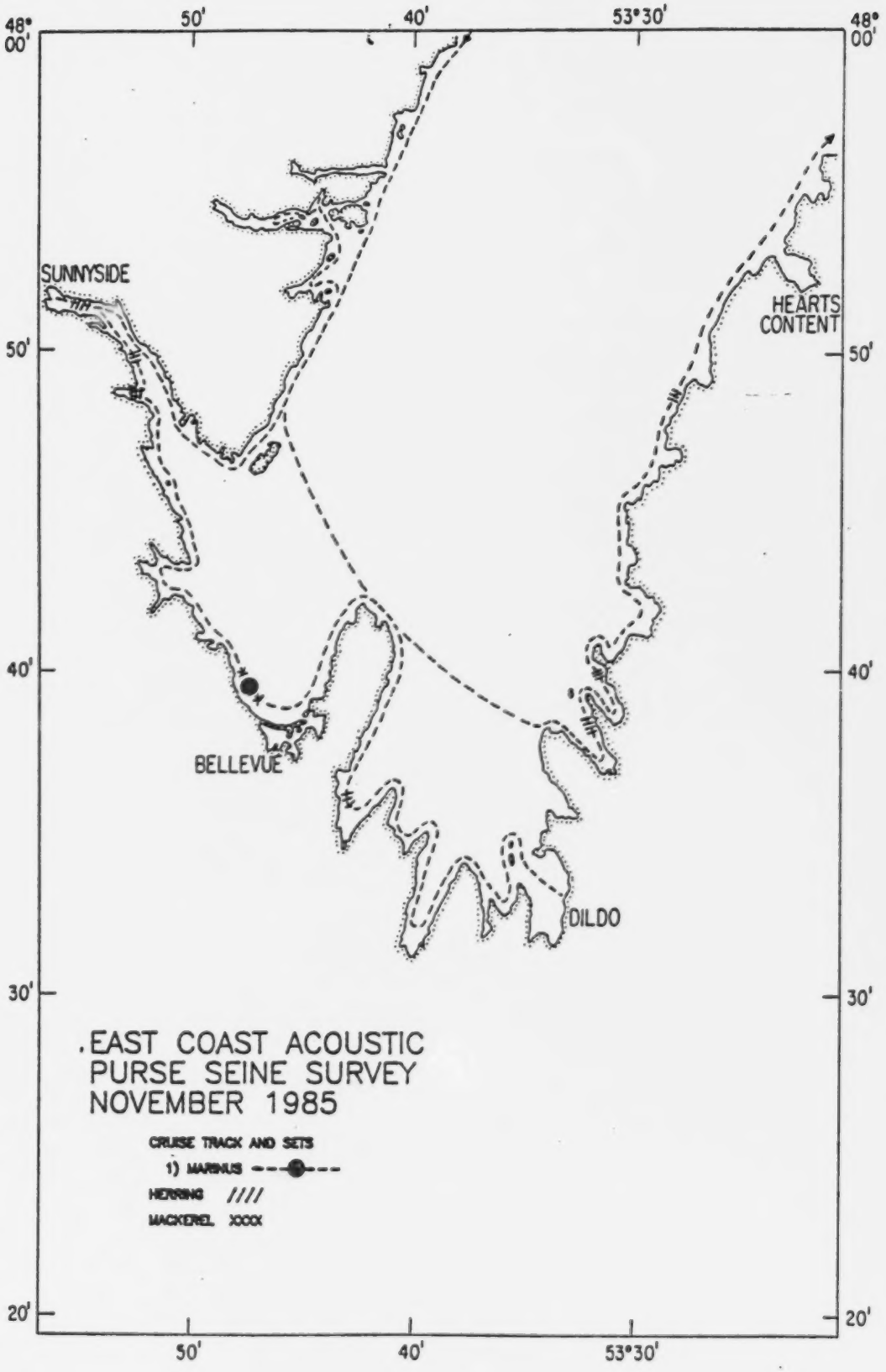
App. 10. Cruise track, herring markings, and set locations, acoustic purse seine survey, Smith and Random Sounds T.B., 1985.



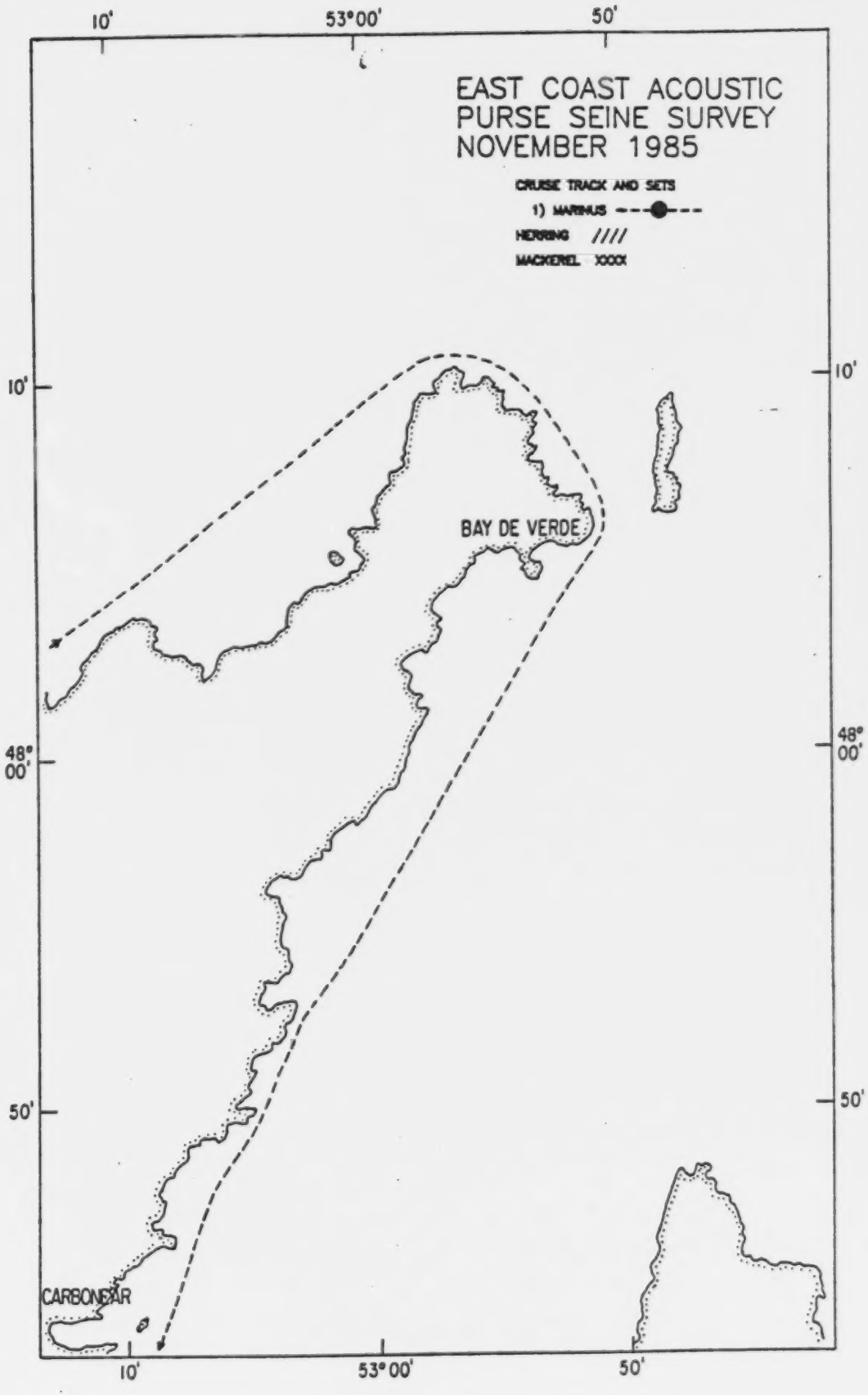
App. 11. Cruise track, herring markings, and set locations, acoustic purse seine survey, inner Trinity Bay, 1985.



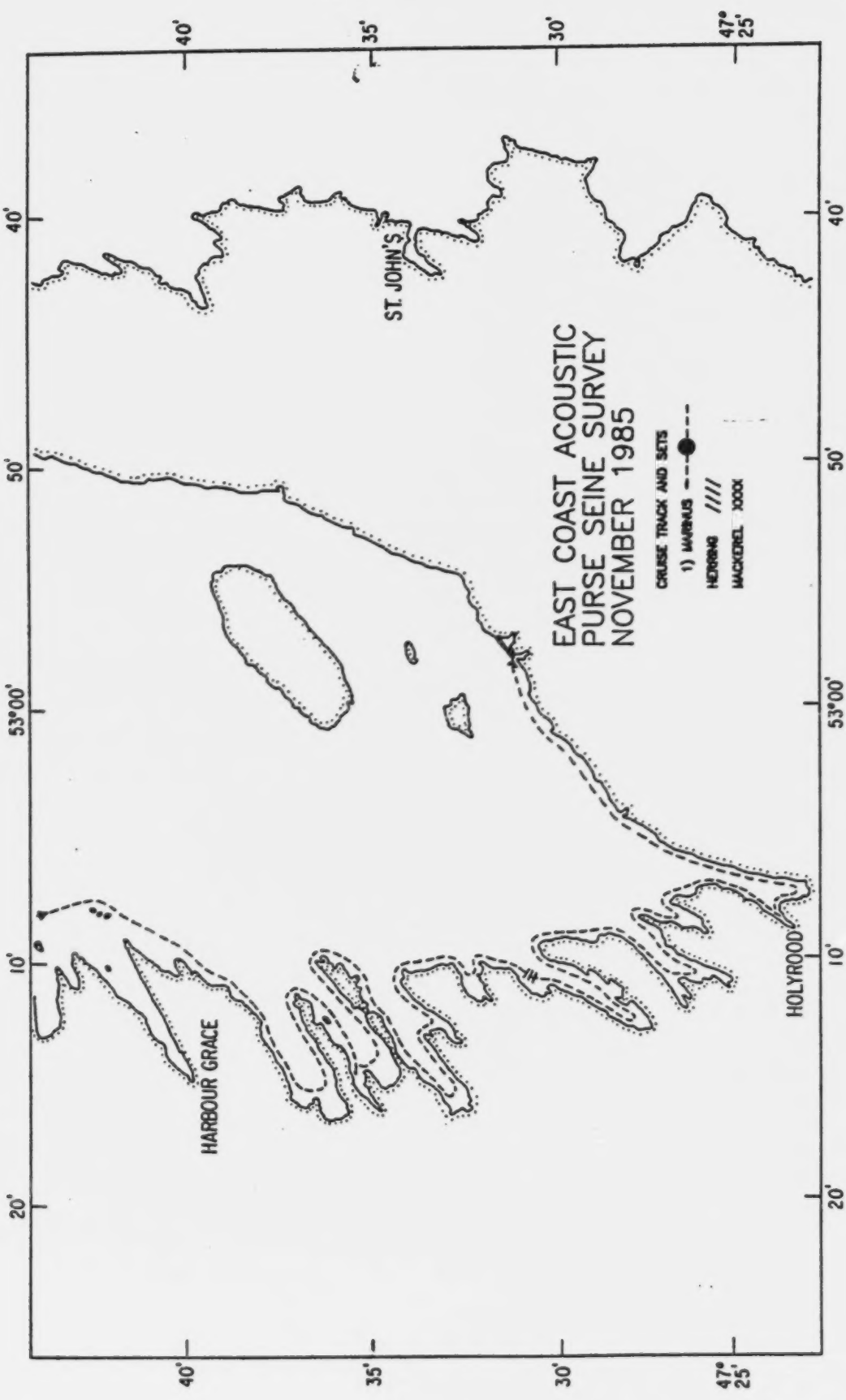
App. 12. MARINUS cruise track, herring markings, and set locations, acoustic purse seine survey, Smith and Random Sounds T.B., 1985.



App. 13. MARINUS cruise track, herring markings, and set locations, acoustic purse seine survey, inner Trinity Bay, 1985.



App. 14. MARINUS cruise track, herring markings, and set locations, acoustic purse seine survey, Trinity – Conception Bays, 1985.



App. 15. MARINUS cruise track, herring markings, and set locations, acoustic purse seine survey, inner Conception Bay, 1985.

Appendix 16. Purse seine set details, east coast acoustic survey, October-November 1985.

Vessel set no.		Date	Time	Location	Surface temp. (°C)	Catch weight (kg)	Mean length (mm)	Sample no.	Comments
CIV	LF								
-	1	Oct. 9	0840	Red Point, Mings Bight	7.6	(2 fish)	-	-	Caught two mackerel only
1	-	Oct. 9	0850	Point Rousse, Mings Bight	7.8	-	-	-	No catch, probably mackerel
-	2	Oct. 9	0940	Red Point, Mings Bight	7.6	(6 fish)	-	-	Caught six mackerel only
2	-	Oct. 9	1910	Middle Arm, Green Bay	8.0	45,000	264	H1	Caught small portion of school, 78% '82 yc; 22% '83 yc
3	-	Oct. 10	0920	Rattling Brook, Green Bay	7.8	(7 fish)	-	-	Caught six cod and one mackerel
-	3	Oct. 10	0925	Stearing Rock, Rattling Bk.	8.1	(3 fish)	-	-	Caught three cod only
-	4	Oct. 10	1015	Rattling Brook, Green Bay	7.9	90	-	-	Caught approx. 90 kg cod and one haddock
4	-	Oct. 10	1545	Southern Arm, Green Bay	8.2	18,000	281	H2	Caught entire school, 58% '82 yc; 16% '83 yc
5	-	Oct. 13	1720	Brimstone Head, New Bay	9.0	5,000	256	H3	Caught portion of school, 76% '83 yc; 24% '82 yc
-	5	Oct. 14	1250	Osmonton Arm, New Bay	9.0	-	-	-	No catch
-	6	Oct. 14	1830	Hummock Is., Bay of Exploits	8.0	-	-	-	Seine full of sticklebacks, plus one herring and six mackerel
6	-	Oct. 14	1920	Exploits Island Tickle	8.2	(37 fish)	183	H4	Seine pursed shallow, caught 37 herring, 62% '82 yc; 24% '83 yc
-	7	Oct. 16	1420	Browns Arm, Bay of Exploits	8.8	9,000	238	H5	Caught entire school, 100% '83 yc
7	-	Oct. 22	1655	Indian Bay, Bonavista Bay	6.2	-	-	-	No catch; fish deep
-	8	Oct. 22	1750	Indian Bay, Bonavista Bay	6.2	14,000	259	H6	Caught 70% '83 yc; 28% '82 yc
8	-	Oct. 23	1050	Black Duck Cove, Trinity	6.8	-	-	-	No catch, deep water, fish wild
9	-	Oct. 23	1135	Black Duck Cove, Trinity	6.8	23,000	281	H7	Caught entire school, caught 92% '82 yc; 4% '79 yc
-	9	Oct. 23	1320	Lewis Island, Bonavista Bay	6.8	-	-	-	No catch
-	10	Oct. 23	1620	Shoal Bay, Dover	7.0	14,000	251	H8	Caught 86% '83 yc; 14% '82 yc
-	11	Oct. 26	0955	Middle Tickle, Long Is.	8.0	5,000	283	H9	Caught 86% '82 yc; 8% '83 yc
10	-	Oct. 26	1015	Beaver Cove, Long Is.	7.6	-	-	-	No catch, fish wild and deep
11	-	Oct. 27	1400	Middle Pt., Port Blandford	6.8	-	-	-	No catch
12	-	Oct. 27	1430	Middle Pt., Port Blandford	6.8	-	79	H10&11	Caught approx. 1000 '85 yc; most went thru seine
-	12	Oct. 28	0720	Great Chance Hr.	7.6	3,000	247	H12	Caught 90% '83 yc; 10% '82 yc
13	-	Oct. 29	0825	Bonavista	6.8	-	-	-	No catch, seine purse shallow due to wind
14	-	Oct. 30	0835	Fox Head, Port Rexton	6.4	-	-	-	No catch, too windy
-	13	Oct. 30	0905	Fox Cove, Port Rexton	6.6	-	-	-	No catch, too windy
15	-	Oct. 30	1210	Bonaventure Head	6.3	-	-	-	No catch, fish wild
16	-	Oct. 31	0940	Anthony and Duck Islands	6.8	-	-	-	No catch
17	-	Oct. 31	1225	East Random Head	-	-	-	-	Set on mackerel breech, no catch, tore seine
-	14	Nov. 4	1550	Thoroughfare, Irelands Eye	6.6	5,000	287	H13&14	Caught 96% '82 yc
1(Marinus)		Nov. 10	1230	Bellevue Beach	7.2	(26 fish)	-	-	Caught 26 juvenile mackerel

Appendix 17. Herring tagging experiments, east coast acoustic survey, October-November 1985.

Date	Time	Location	No. tagged	Tag series	Comments
Oct. 9	1920	Middle Arm, Green Bay	1000	22501D - 23500D	78% '82 yc, 22% '83 yc
Oct. 13	1730	Brimstone Head, Pt. Leamington	1000	23501D - 24500D	76% '83 yc, 24% '82 yc
Oct. 16	1430	Browns Arm, Bay of Exploits	1000	24501D - 25500D	100% '83 yc
Oct. 22	1800	Indian Bay, Bonavista Bay	1000	25501D - 26500D	70% '83 yc, 28% '82 yc
Oct. 26	1010	Middle Tickle, Long Island	1000	26501D - 27500D	86% '82 yc, 8% '83 yc
Oct. 28	0730	Great Chance Hr., Bonavista Bay	1000	27501D - 28500D	90% '83 yc, 10% '82 yc
Nov. 4	1600	The Thoroughfare, Irelands Eye	2000	28501D - 30500D	96% '82 yc

Appendix 18. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season (* adjusted to account for shallow nets).

AREA	SEASON	AGE	1980*	1981*	1982*	1983	1984	1985
			AUTUMN SPAWNERS					
WB-NDB	FALL	1	-	-	-	-	-	-
		2	-	-	-	-	-	-
		3	465	36	633	11	2513	10
		4	63	130	312	2047	370	290
		5	206	6	351	238	7364	286
		6	253	51	305	613	1841	2657
		7	259	5	8	197	227	1432
		8	14	27	6	27	190	13
		9	22	-	139	44	57	10
		10	-	-	-	124	44	5
		11+	600	28	33	274	598	441
		TTL	1881	284	1786	3576	13204	5145
			SPRING SPAWNERS					
			1980*	1981*	1982*	1983	1984	1985
		1	3	-	-	-	-	-
		2	1383	705	779	53	4194	518
		3	1172	817	2688	7224	1146	25839
		4	28735	179	515	11780	3431	3626
		5	974	3950	315	1068	15124	2226
		6	12983	160	178	2058	778	11544
		7	360	833	72	2896	1522	1317
		8	4109	74	844	347	2544	1297
		9	619	314	-	3247	180	1430
		10	4760	126	1432	761	1516	1003
		11+	71096	13087	17733	46209	45887	22918
		TTL	126189	20244	24554	75642	76322	71718
			AUTUMN AND SPRING SPAWNERS COMBINED					
			1980*	1981*	1982*	1983	1984	1985
		1	3	-	-	-	-	-
		2	1383	705	779	53	4194	518
		3	1636	853	3321	7234	3659	25849
		4	28798	309	825	13827	3801	3916
		5	1180	3955	666	1306	22487	2512
		6	13236	211	483	2671	2619	14201
		7	619	838	79	3093	1749	2749
		8	4122	102	852	374	2734	1311
		9	641	314	139	3291	238	1440
		10	4760	126	1432	885	1560	1008
		11+	71695	13117	17766	46483	46485	23360
		TTL	128070	20528	26340	79218	89526	76863

Appendix 19. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season (* adjusted to account for shallow nets).

AREA	SEASON	AGE	1980*	1981*	1982*	1983	1984	1985
			AUTUMN SPAWNERS					
BB-TB	FALL	1	-	-	-	-	-	-
		2	-	-	-	-	-	-
		3	99	1	3071	36	74	61
		4	160	170	481	5279	203	156
		5	66	30	1598	1327	3907	131
		6	154	22	53	1559	847	1467
		7	336	19	269	364	826	638
		8	80	302	17	231	77	135
		9	33	3	777	98	315	45
		10	-	-	-	687	-	8
		11+	267	155	826	704	736	195
		TTL	1199	699	7090	10285	6986	2837
			SPRING SPAWNERS					
			1980*	1981*	1982*	1983	1984	1985
		1	-	-	-	-	-	-
		2	2714	166	761	138	3046	356
		3	168	235	10889	1290	1285	8405
		4	1694	31	2918	16008	1239	668
		5	110	97	735	1709	9579	302
		6	564	25	2140	655	469	1342
		7	36	196	9	1801	217	84
		8	99	-	429	24	344	23
		9	28	155	-	715	-	93
		10	242	6	95	135	304	-
		11+	13354	7783	9550	15076	7476	2934
		TTL	19005	8695	27523	37551	23959	14206
			AUTUMN AND SPRING SPAWNERS COMBINED					
			1980*	1981*	1982*	1983	1984	1985
		1	-	-	-	-	-	-
		2	2714	166	761	138	3046	356
		3	267	236	13960	1325	1359	8466
		4	1854	201	3396	21287	1442	824
		5	176	127	2328	3036	13486	433
		6	718	47	2196	2215	1316	2809
		7	374	214	278	2165	1043	722
		8	179	302	445	254	421	158
		9	61	158	777	813	315	138
		10	242	6	95	822	304	8
		11+	13621	7935	10376	15780	8212	3129
		TTL	20204	9393	34613	47836	30945	17043

Appendix 20. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season (* adjusted to account for shallow nets).

AREA	SEASON	AGE	AUTUMN SPAWNERS 1980	1981	1982	1983*	1984	1985
BB-TB	SPRING	1	-	-	-	-	-	-
		2	-	-	-	-	-	-
		3	-	-	-	6	-	-
		4	-	-	-	33	-	2
		5	-	-	-	3	311	19
		6	-	-	-	3	50	409
		7	-	-	-	-	-	72
		8	-	-	-	3	-	49
		9	-	-	-	-	3	-
		10	-	-	-	-	-	5
		11+	-	-	-	14	17	28
		TTL	-	-	-	61	382	585

	SPRING SPAWNERS 1980	1981	1982	1983*	1984	1985
1	-	-	-	-	-	-
2	-	-	-	-	8	-
3	-	-	-	22	161	697
4	-	-	-	179	65	289
5	-	-	-	6	301	165
6	-	-	-	-	29	426
7	-	-	-	3	5	39
8	-	-	-	-	18	37
9	-	-	-	50	-	38
10	-	-	-	8	17	40
11+	-	-	-	905	1171	1495
TTL	-	-	-	1169	1775	3226

	AUTUMN AND SPRING SPAWNERS COMBINED 1980	1981	1982	1983*	1984	1985
1	-	-	-	-	-	-
2	-	-	-	-	8	-
3	-	-	-	28	161	697
4	-	-	-	212	65	291
5	-	-	-	8	612	184
6	-	-	-	3	79	835
7	-	-	-	3	5	110
8	-	-	-	3	18	86
9	-	-	-	50	3	38
10	-	-	-	8	17	45
11+	-	-	-	919	1189	1523
TTL	-	-	-	1229	2157	3811

Appendix 21. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season.

AUTUMN SPAWNERS

AREA	SEASON	AGE	1980	1981	1982	1983	1984	1985
CB-SS	FALL	1	-	-	-	-	-	-
		2	-	-	-	58	-	-
		3	-	-	-	7	229	280
		4	-	-	-	137	201	804
		5	-	-	-	24	6837	472
		6	-	-	-	38	1260	3376
		7	-	-	-	3	332	1046
		8	-	-	-	2	36	691
		9	-	-	-	32	57	3
		10	-	-	-	-	33	5
		11+	-	-	-	22	41	402
		TTL	-	-	-	323	9026	7079

SPRING SPAWNERS

AGE	1980	1981	1982	1983	1984	1985
1	-	-	-	-	-	-
2	-	-	-	70	2565	75
3	-	-	-	37	597	29034
4	-	-	-	62	2174	1623
5	-	-	-	6	4162	930
6	-	-	-	8	275	1139
7	-	-	-	9	224	4
8	-	-	-	-	426	66
9	-	-	-	10	-	79
10	-	-	-	8	-	-
11+	-	-	-	218	2841	2644
TTL	-	-	-	428	13263	35594

AUTUMN AND SPRING SPAWNERS COMBINED

AGE	1980	1981	1982	1983	1984	1985
1	-	-	-	-	-	-
2	-	-	-	128	2565	75
3	-	-	-	44	826	29314
4	-	-	-	199	2374	2427
5	-	-	-	30	10999	1402
6	-	-	-	46	1535	4516
7	-	-	-	12	556	1049
8	-	-	-	2	461	757
9	-	-	-	42	57	82
10	-	-	-	8	33	5
11+	-	-	-	239	2883	3046
TTL	-	-	-	751	22289	42673

Appendix 22. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season.

AREA	SEASON	AGE	AUTUMN SPAWNERS 1980	1981	1982	1983	1984	1985
CB-SS	SPRING	1	-	-	-	-	-	-
		2	-	-	-	-	-	-
		3	-	-	-	-	-	-
		4	-	-	-	-	-	54
		5	-	-	-	-	-	81
		6	-	-	-	-	-	1624
		7	-	-	-	-	-	1266
		8	-	-	-	-	-	1017
		9	-	-	-	-	-	219
		10	-	-	-	-	-	118
		11+	-	-	-	-	-	1655
		TTL	-	-	-	-	-	6033
			SPRING SPAWNERS					
			1980	1981	1982	1983	1984	1985
		1	-	-	-	-	-	-
		2	-	-	-	-	-	-
		3	-	-	-	-	-	506
		4	-	-	-	-	-	101
		5	-	-	-	-	-	397
		6	-	-	-	-	-	1141
		7	-	-	-	-	-	152
		8	-	-	-	-	-	133
		9	-	-	-	-	-	28
		10	-	-	-	-	-	-
		11+	-	-	-	-	-	7973
		TTL	-	-	-	-	-	10431
			AUTUMN AND SPRING SPAWNERS COMBINED					
			1980	1981	1982	1983	1984	1985
		1	-	-	-	-	-	-
		2	-	-	-	-	-	-
		3	-	-	-	-	-	506
		4	-	-	-	-	-	155
		5	-	-	-	-	-	477
		6	-	-	-	-	-	2765
		7	-	-	-	-	-	1418
		8	-	-	-	-	-	1150
		9	-	-	-	-	-	247
		10	-	-	-	-	-	118
		11+	-	-	-	-	-	9628
		TTL	-	-	-	-	-	16464